PROCEEDINGS

OF THE

NINTH

WEST INDIAN AGRICULTURAL CONFERENCE.

KINGSTON, JAMAICA,
JANUARY, 1924.

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WEST INDIAN AGRICULTURAL CONFERENCE, 1924.

The greater number of the delegates to the Conference arrived at Kingston, Jamaica, on Monday, Jan. 28, by the S.S. "Coronado" from England via Trinidad and Central America. On arrival they were met at the wharf by several of the Jamaica delegates, including the Colonial Secretary, Colonel the Hon. H. Bryan, C.M.G., D.S.O; the Director of Agriculture, Mr. H. H. Cousins, M.A.; and Messrs. C. C. Gowdey and C. G. Hansford, Joint Secretaries of the Conference.

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The ninth West Indian Agricultural Conference met at the Ward Theatre, Kingston, Jamaica, at 2.15 p.m. on Monday, the 28th January, 1924. Present: His Excellency Sir LESLIE PROBYN, K.C.M.G., Governor of Jamaica, and the following delegates:—

Sir A. E. SHIPLEY, G.B.E., L.L.D., Sc. D., F.R.S. (Chairman); G. MOODY STUART, Esq. (Chairman of Finance Committee), Imperial College of Tropical Agriculture; Sir FRANCIS WATTS, K.C.M.G., D. Sc., F.I.C., F.C.S., (Principal, Imperial College of Tropical Agriculture and Imperial Commissioner of Agriculture for the West Indies).

Mr. H. S. BALLOU, M.Sc. (Professor of Zoology and Entomology and Assistant Commissioner of Agriculture); Mr. S. F. ASHBY, B.Sc. (Professor of Mycology and Bacteriology), and Mr. S. C. HARLAND, D.Sc., F.L.S., F.E.S. (Professor of Botany), representing the Imperial College of Agriculture and Imperial Department of Agriculture, Trinidad.

Mr. W. NOWELL, D.I.C. (Assistant Director of Agriculture and Mycologist), and Mr. W. S. E. BARNARDO, M.A. (Chairman, Agricultural Society), Trinidad.

Bt.-Colonel The Honourable H. BRYAN, C.M.G., D.S.O. (Colonial Secretary), Mr. H. H. COUSINS, M.A. (Director of Agriculture); Mr. W. A. BAKER, F.S.I., (Surveyor General); Mr. C. C. GOWDEY, B.Sc., F.E.S., F.Z.S. (Government Entomologist); Mr. C. G. HANSFORD, M.A., (Government Microbiologist); Mr. S. LOCKETT, V.M.D. (Government Veterinary Surgeon); Mr. P. W. MURRAY (Superintendent of Agriculture); HON. W. B. ISAACS, (Island Treasurer); Mr. S. S. STEDMAN, (Advisory Committee on Banana Industry) Hon. A. G. NASH, B.Sc., F.R.S.E., F.R.G.S., A.M.I.C.E. (Board of Management, Lititz Fibre Plantation); Mr. E. W. MUIRHEAD (Board of Management, Grove Place Stud Farm); Mr. J. F. BRENNAN, A.M.I.C.E., F.R.M.S., (Government Meteorologist); representatives of the Jamaica Government.

Mr. A. H. SPOONER (Member Board of Management), and Mr. J. BARCLAY (Secretary), the Jamaica Agricultural Society.

Mr. R. S. GAMBLE and Hon. H. V. MYERS, M.B.E., Jamaica Chamber of Commerce.

Hon. A. E. HARRISON, B.A., and Hon. P. C. CORK, C.M.G., the Jamaica Imperial Association.

Mr. R. A. ALSTON, A.R.C.S., B.Sc. (Assistant Government Botanist and Mycologist), British Guiana.

Mr. J. R. BOVELL, I.S.O., F.L.S., F.C.S. (Director of Agriculture), Barbados.

Hon. J. T. De La MOTHE, Grenada.

Hon. R. NOSWORTHY (Acting Collector General, Jamaica and recently Administrator of Dominica) Leeward Islands.

Mr. E. STANLEY WOODS, British Honduras.

Mr. G A. ALBURY (Chairman Board of Agriculture), Bahamas.

Mr. L. OGILVIE, M.A., B.Sc., M.Sc., (Plant Pathologist), Bermuda.

Captain A. W. HILL, F.R.S., M.A., Sc. D., F.L.S. (Director Royal Botanic Gardens, Kew); Mr. S. P. WILTSHIRE, M.A., Imperial Bureau of Mycology.

Dr. S. A. NEAVE (Assistant Director) Imperial Bureau of Entomology.

Mr. E. A. DEPASS and Mr. A. E. ASPINALL, C.M.G., B.A., West India Committee.

Mr. R. G. W. FARNELL, B.A. (Chemist), British Empire Sugar Research Association.

President of the Conference—Sir FRANCIS WATTS, K.C.M.G., D.Sc.

Joint Secretaries—Messrs. C. C. GOWDEY, B.Sc., and C. G. HANSFORD, M.A.

PROCEEDINGS OF CONFERENCE.

The Governor: At the beginning of the Conference, it is right that we should begin with prayer. I ask the Rev. Mr. Graham to offer prayer.

The Hon. and Rev. W. T. Graham offered the following prayer:—

"Prevent us, O Lord in all our doings, with Thy most gracious favour and further us with Thy continual help, that in all our works begun, continued and ended in Thee, we may glorify Thy Holy name and finally by Thy Mercy, obtain everlasting life, through Jesus Christ our Lord."

The Governor said : "In the first place, I desire on behalf of this colony, to extend first a welcome to those who have travelled so far in order to attend the Conference. Secondly, I desire to tender our thanks to them for the effort which they have made so keenly in order to be here, with a view to making this Conference a gathering which will yield useful results. The Conference, as you know, is the outcome of a suggestion made by Major Wood, the then Under-Secretary of State for the Colonies. As the result of his visit to the West Indies, it became obvious to him that the bond binding one part of the West Indies to the other—one part of the British West Indies to the others—is the bond which exists with respect to the necessity for doing all that is possible to improve agriculture. It does seem that all the West Indies live by agriculture, the only exception that I know of being the Pitch Lake of Trinidad.

Some people are rather apt to question the utility of a Conference or a Congress. But very little reflection is needed to show that a Conference or Congress is an arrangement by which useful results and very substantial gains can be achieved. Exactly ten years ago, I think in June, 1914, there was an International Congress on Tropical Agriculture. At that time one of the proposals standing in the fore-front as regards importance, was the proposal that there should be established an Imperial College of Tropical Agriculture. It is perhaps interesting to recall that at that day, opinion seemed to be strongly in favour of establishing an Agricultural College for Tropical Agriculture in the Colony of Ceylon. One reason advanced in favour of the selection of Ceylon, is a reason which I quote with a certain amount of trepidation, for the reason that

it teems with that which has been a matter of controversy in this ancient colony. The reason for selecting Ceylon was that Ceylon has a great variety of climate. As you all know, the claim here was that Jamaica, by reason of its variety of climate, different soils, and variety of agricultural industries, should have the College—that Jamaica was better fitted than any other place in the West Indies for the establishment of the Imperial College of Tropical Agriculture (Voices: Hear, hear). I think that that view was the dominant reason why up to date there has been what I might term a cautious hesitancy on the part of the Legislature of Jamaica, in supporting the College. But to-day we know that the stone, the foundation stone of the College has been laid. We know there is no use in our following the example of Mr. Micawber, and waiting for something to turn up, which will remove the College from Trinidad to Jamaica. Its establishment in Trinidad is a fact, and in view of that fundamental fact, I feel very confident that the Legislature of this Colony will realise that the College has been established, and that we should support it to the best of our means. (Hear, hear.)

Refering to the International Congress of 1914, my object was to give one illustration as to how it comes about that the conclusions of a gathering such as this have in actual fact led to valuable work, because the resolutions or opinions arrived at ten years ago, have to-day found themselves expressed in actuality; in that there is now an Imperial College of Tropical Agriculture in the West Indies. (Hear, hear.) There are other reasons that may be advanced as regards the utility of a Conference. To take a commonplace illustration: we know that cricketers when they foregather together, talk over with one another about the game, with the result that something is added to the mastery of the game. It is the same with golfers and fishermen. But, as you know, golfers and fishermen are connected in some minds with tall stories, and I will not allude to them any more. Take the game of cards: what bridge players are there, who, on coming together do not discuss the problems of the game, to their mutual advantage. For these and other obvious reasons, it is quite clear that, on agriculturists gathering together, those who have personal experience in agriculture, those who know the science of agriculture, those who know of the chemistry of agriculture, those who know of the foundation of agriculture, that is, botany—when all those gather together and talk, the result must tend towards advance in agriculture, and show the value of a Conference (hear, hear). I venture to suggest a higher, a more far-reaching gain from such Conference. It is quite true that an immense amount can be learnt from books and other scientific pamphlets, and nobody who has read the literature which is prepared by the Imperial Bureau of Entomology, can fail to realise that that is literature of a highly enriching kind. And the same may be said of the literature prepared by the Imperial Bureau of Mycology. But I think you will all agree, as regards this somewhat discouraging fact, that literature is not always read with that careful attention which enables the reader to grasp thoroughly the whole value of the information imparted. An illustration will demonstrate that. If you were to present even to this highly cultured gathering on this platform, and down there, in the body of the hall, copies of some of the pamphlets issued by these two Bureaus and to cross-examine the readers afterwards, you would find there were great gaps in the amount of information which the readers had respectively imbibed. Reading is valuable, but the conversation of man to man often achieves that which cannot be done by reading, and that is the value of the Conference.

We know that mankind is ever making progress towards finding out the system by which the universe is governed The progress is both slow and spasmodic, and, metaphorically, this is because the governing principles are manifested by hieroglyphics which are both scattered and intricate. Thus, an inquirer may discover a single hieroglyphic which, being solitary, cannot be deciphered either with certainty or with useful result. A second and a third and a fourth inquirer may each have a similar experience. Obviously, in all such cases, not one of the inquirers has sufficient justification for describing his discovery in a scientific paper or at a lecture. But if a Conference is held, then, possibly, the enquirers may talk together in a way which leads to each one of the hieroglyphics being absolutely described. And, ultimately, owing to the conference, the hieroglyphics may be deciphered, thereby revealing something which is of great use and permanent benefit to mankind. You have there three at least very strong reasons which encourage us to believe that this Conference will have useful results. The agenda is interesting and lengthy.

In Jamaica some people are cutting down their cocoa trees, finding it more profitable to grow bananas. That may be all right, but it is a matter for consideration whether there is not a better way, if the remedy is not in the direction which aims at, firstly, reducing the cost of production by increasing efficiency; secondly, at improving the quality of goods placed on the market; and, thirdly, at reducing the middlemen's charges. Above all seems hope in the proposal to produce a superior quality of chocolate and cocoa and place it in the United Kingdom by selected manufacture of West Indian cocoa.

With regard to cotton, it must be admitted that in Jamaica our output is very small, but possibly a new sort of cotton may be introduced which will have special value as regards meeting the present market requirements. They say that, subject to climate, it is possible that cotton cultivation may be increased here.

With regard to sugar, the Conference might like to know what is being done in Jamaica with respect to combating the Mosaic disease. Action here consists first of all, in employing Inspectors. Besides that, efforts are made to organise public opinion, so that there shall be a universal campaign against the disease, and thirdly, the Government have, with the assistance of the Agricultural Society, without whom the Government would be comparatively helpless—as powerless as a man without arms—have arranged for the establishing of nurseries for disease-free canes, such as the white Transparent, and the Barbados cane B.H. 10 (12), a cane, the value of which has been proved in Jamaica, a cane which has enriched the sugar world solely on account of the industry and talent of Mr. John Bovell, of Barbados (Applause).

With regard to the coconut industry, which is an important one, the rumour that the Fiji coconut was especially valuable, reached Jamaica, and we obtained some of the Fiji coconuts. The further supply was stopped, because it was considered too risky to import any more owing to the risk of importing certain diseases. The Fiji nuts imported into Jamaica have not made great progress. In fact, well selected Jamaica coconuts seem to be the most satisfactory nuts to plant. It might interest the Conference to know that in Jamaica, after the hurricane, the greater part of the coconut cultivations were threatened with calamity in this way. The previous hurricane had mutilated the trees, weakening them, and the result was these same mutilated and weakened trees became victims of Budrot. The only one thing to do was to destroy every weakened and infected tree, and something like 50,000

coconut trees were destroyed. It was by co-operation between the Government and the owners, great and small, that this was brought about. In every case, disease-free plants have taken their place, so that to-day, one can claim that that particular disease is very rare indeed in Jamaica. So that you see, that even a hurricane may have good results. In this case, our great gain has been that we have become comparatively free from disease of that kind.

The orange industry has been in tribulation, in so much that the orange as a fruit, has almost ceased to be exported: the land owners find that the sole way in which they can make any profit from their plantations is by extracting the oil from the orange. The difficulty was due to shipping—to lack of adequate shipping facilities. At the present, time, things look a little brighter, and there is an investigation now on foot, which may lead to good results. It is an investigation to ascertain whether the oil can be extracted from the Seville or sour orange, and whether after these oranges have been rinded, they can be shipped as pulp for sale in England, preferably in Scotland, as material for marmalade. If that should prove to be a success, then, obviously, there will be the chance of getting the profit from the by-products.

There is no industry from which greater lessons can be learnt in Jamaica than the cattle industry. It is a very ancient industry here. The very name "pen" shows how old it is. I should like to say more about the cattle industry, only that is one line which is barred, because of the Foot and Mouth disease. I have read a great deal about the Foot and Mouth disease, and I have heard a hundred times more in talk than I have read, but I confess, standing here, that I have no clear idea about Foot and Mouth disease—about spores and the safest way of eliminating all risks. So I think that I had better say no more about that subject. There is, however, one feature about cattle, which I may refer to, and that is the great success attendant on the Colony's efforts to stamp out the cattle tick. All the cattle owners throughout Jamaica have been enthusiastic in carrying out the anti-tick legislation. That in itself is a very great thing to say. Legislation can be made very drastic, but the advantage of the cattle dipping is of a kind so immediate, taking effect within two or three days, that there has been very little difficulty. I think within five or six years the tick will cease to be a source of trouble to the cattle of Jamaica. That will be a great gain.

One reason why it was agreed that an Imperial College of Tropical Agriculture was necessary, was on account of the special difficulties with which the agriculturists have been coping in the tropics. Of these difficulties, one of the most formidable was the hurricane. Efforts have been made to insure—to make it possible to insure against the risks of hurricane. At the present moment, that effort is still in the making. I do not know whether it will succeed or not. I hope it will, for it will be a great gain to have a system of insurance which, at least, will enable the banana grower to sleep in relative peace. As regards the scientific aspects of the question, there is a proposal on the agenda with reference to finding out more about the laws of hurricanes. This is to be done by means of balloons sent up into the higher stratas of the air.

I trust that the members will forgive me for having spoken at such great length. I have endeavoured to call their attention to some of the items of interest which will be discussed during the Conference. There is one item I have not referred to at all. It is the question of Agricultural Education, the most important subject of all. There is one feature in Jamaica which may be interesting, and that is that at the bottom of the ladder as regards age, there is a chance of learning to become interested

in agriculture. This chance is provided by a rule by the Board of Education. The rule is to the effect that all elementary education should be given by using school gardens as a medium for education. Perhaps some of those who attend the Conference may like to have further information on this subject. If that should be the case, I can now assure them that it will be most readily given (applause).

I now propose that Sir Francis Watts take the chair, and preside over the Conference. Those in favour kindly signify in the usual manner.

The Governor's proposal was carried, and Sir Francis Watts took the chair, with acclamation.

Sir Francis Watts: Before we proceed further with the business of the afternoon, it is very desirable that we should send a formal address of loyalty and devotion to His Majesty the King. I have pleasure in asking Mr. Harrison to be good enough to move the sending of such a resolution to His Majesty the King (applause).

Hon. A. E. Harrison (Custos of St. Elizabeth): Your Excellency, Lady Probyn, Sir Francis Watts, ladies and gentlemen. I have great pleasure in moving the following resolution to be sent to His Majesty the King:—

> "Delegates from the British West Indian Colonies, the Bahamas, British Guiana and British Honduras and Bermuda assembled for the Ninth Agricultural Conference held under the auspices of the Imperial Department of Agriculture, desire respectfully to convey to His Majesty the King, the expression of their devoted loyalty" (applause).

In moving this resolution, I do not think any words of mine are necessary because this is an ancient and loyal possession of the Crown with a long tradition for loyalty. The resolution might take even a higher stand, because I feel that with all the deep anxiety that His Majesty has at home, still this Agricultural Conference is in his mind. I feel sure he will regard the resolution almost as a personal resolution to him (applause). I would like you all to stand in passing this resolution.

Mr. J. R. Bovell (Barbados): I have very much pleasure, on behalf of the ancient colony of Barbados, which I represent, to second the resolution. It is hardly necessary for me to say anything more.

Sir Francis Watts: I have to formally put the resolution to the meeting, although I have no doubt it will be passed with acclamation. Those in favour of it will signify by clapping. The resolution will be cabled over to the King.

The resolution was carried on a standing vote.

Sir Francis Watts: It is also desirable that we send a resolution to the Right Hon. the Secretary of State, in connection with the Conference because of the interest taken by the Secretary of State and the Colonial Office in these colonies. It is at the instance of the Secretary of State that this Conference has been called together. I have pleasure in asking Mr. Baggett Gray to move, and Mr. Albury to second, a resolution.

Mr. Bagget Gray: Your Excellency and Lady Probyn, Sir Francis Watts, ladies and gentlemen, I have pleasure in moving the following resolution:—

"Delegates from the British West Indies, the Bahamas, British Guiana, British Honduras, and Bermuda, assembled for the Ninth Agricultural Conference held under the auspices of the Imperial Department of Agriculture, desire to record their appreciation of the interest which your department shows in the agricultural interests of those colonies.

"Further, they wish to express their regret that owing to the exigencies of the political situation you were prevented from visiting the West Indies and British Guiana this year."

In putting this resolution to you, you will notice there is a personal note at the end of it. It is addressed to Mr. Thomas, the present Secretary of State for the Colonies, in the Labour Government (hear, hear). I need not remind you that it was his intention to come out to Jamaica and the West Indies, but he is prevented by the new Government that has cone into office. The Colonial Office has for years past given very generous encouragement indeed to the West Indies in regard to agriculture. After the earthquake, I think they gave a large sum of money, about £50,000.They have subsidized the Imperial Department of Agriculture in the West Indies, which has had as its Commissioner such an able and experienced officer as Sir Francis Watts, for years. They have subsidized the Imperial College of Agriculture for the West Indies for three years now, and we all know the preference they granted to our sugar, and we have hopes that that preference will be stabilized for 10 years. In view of the benefits we derived from, and the interest displayed in us by, the Colonial Office, I am sure this resolution which I am now moving, at the request of the Chairman, will meet with your approbation (applause).

Mr. G. A. Albury (Bahamas): I have great pleasure in seconding the resolution.

Sir Francis Watts: Is it the pleasure of this meeting that this resolution be agreed to and forwarded by cable to the Secretary of State for the Colonies? Those in favour will signify in the usual manner.

The resolution was unanimously carried.

Sir Francis Watts: Before we proceed with the other business—the giving of my formal address—I would like to ask Mr. DePass who represents the West India Committee to give a message, which I understand he has brought out from that body to us to-day (applause.)

Mr. A. E. DePass (West India Committee, London): Your Excellency, Lady Probyn, ladies and gentlemen. The previous Secretary of State for the Colonies, His Grace the Duke of Devonshire, having requested the West India Committee to appoint a delegate to this Conference, my colleagues of the Executive Council were good enough to select my unworthy shoulders to bear that honour, and, I may add, that great pleasure. I have to confess that my only qualifications are the possession of an intense interest in the Agricultural progress and in the general welfare of this section of the Empire, together with a faculty for listening and—for holding my tongue. In this way, I hope without infringing upon the time of the Conference to be enabled to carry back to my Committee much important and interesting information and knowledge which cannot fail to be of service to them in their future deliberations and efforts to support the desires, aspirations and requirements of the planters and farmers of the West Indies and British Guiana. I have now the honour of conveying to the Conference the contents of a cable message which I have received from the Executive of my Committee.

The message begins:—"West India Committee trust all success may attend deliberations of Ninth West Indian Agricultural Conference at Jamaica, appreciating the vital connection between West Indian prosperity and agricultural efficiency and the very great benefit to be derived from mutual interchange of views for the common good." The message ends. Before resuming my seat, I should like to assure

this Conference that the co-operation of the West India Committee and the columns of its circular are always at the service of every movement, agricultural or commercial, with which the interests of the West Indies are in any way bound up. (Applause.)

Sir Francis Watts: Your Excellency, Lady Probyn, ladies and gentlemen, I beg to thank Your Excellency very cordially for the cordial manner in which you have welcomed this Conference, and outlined to us the value which a Conference of this kind can have in the economy of States like the West Indies.

PRESIDENTIAL ADDRESS.

[*After introductory remarks, thanking His Excellency the Governor and the Colony for the welcome accorded to the Conference, Sir Francis Watts gave the following address.*]

As you are aware this is the Ninth General Agricultural Conference which has been held under the auspices of the Imperial Department of Agriculture, the eighth meeting having been held in Trinidad in January, 1912. Owing to the profound disturbances which have taken place since that time it has not been found possible to hold another of these Conferences until now. This present Conference is assembled at Jamaica as the outcome of the suggestion made by the Hon. E. F. Wood, when, as Under Secretary of State for the Colonies, he paid a visit to the West Indies in the Spring of 1922.

We cannot fail to be reminded of the circumstances in which the Conference held in Jamaica in January, 1907, was abruptly terminated by the disastrous earthquake which took place in the afternoon of the day on which the Conference opened; a disaster of the gravest import to the Colony, but which the energy and courage of the community have redeemed and overcome; so that a new and improved city of Kingston has arisen on the devasted area, serving as a monument to that courage and energy.

Originally these Conferences were intended to afford opportunity for the officers in the various Departments of Agriculture working in association with the Imperial Department to consult together in order to formulate their plans for the work of their Departments in the near future and to discuss the results of their activities in the immediate past. The outlook of the Conferences speedily widened and they have been attended by representatives of all sections of the several Colonies, including those concerned in the administration of the Government, those connected with the Agricultural Departments, representatives of the agricultural industries and those concerned with education in its bearing on the agricultural welfare of all the Colonies. In this way, these Conferences have become in a sense, the agricultural Parliament of the West Indies and it is desirable that their activities should be revived after the long interval in which they have unavoidably been in abeyance. They have played an important and useful part in linking together the scattered parts of the West Indies and it has been suggested that Conferences such as these, including an agricultural conference as a unit amongst several others, may form a basis for the guidance of the general administrative activities of the British West Indies.

It is impossible to hold such a gathering as this without referring to the disastrous effects of the late war which has resulted in such profound disturbance of commerce, manufactures and agriculture. The world's outlook is entirely changed and it is necessary for us all to readjust our outlook in order to maintain our very existence. The assembling of the members of this Conference is designed to give opportunities for the exchange of views and opinions and for the putting forward of proposals for the amelioration and advancement of the conditions affecting the West Indies. Not only it is hoped that these ideas will find expression during the formal session of the Conference, but it is probable that much that is useful will result from the interchange of views between delegates in the intervals, between the actual meetings, and during the time that they will be thrown together in travelling to and from Jamaica. In addition to this the intercourse with representative Jamaicans is calculated to be of great benefit in that it will stimulate ideas and bring new aspects into view: thus the problems of all the colonies will come under discussion and ideas will be exchanged which cannot fail to be productive of good.

The importance of this aspect of the gathering is enhanced by the presence of delegates from the United Kingdom, each specially representative of some line of thought or activity of especial interest to us in the West Indies; in this connection I may refer to the presence of Sir Arthur E. Shipley. Dr. A. Hill, Dr. Neave and Mr. Wiltshire, each eminently distinguished in a sphere of work bearing directly on our interests, and whom we cordially welcome.

West Indian industries in common with those of the rest of the world are for the most part suffering from serious depression: it is hoped that not only the formal deliberations of this Conference, but also the free interchange of views for which it affords opportunity, will result in suggestions which will tend to encouragement, relief and improvement in this particular. The major industries of the British West Indies include Sugar, Cacao, Fruit, Coconuts. Cotton, Rice. Food Crops, all of fundamental importance to certain colonies. There are also many subsidiary industries of importance including Coffee, Rubber, Spices, Fibres, Tobacco, and Stock Raising and these are in many cases capable of expansion. It is hoped that all these may be discussed both within and without the Conference.

The sugar industry of the West Indies has been subject to great vicissitudes. Sugar, at one time the mainstay of these Islands and the source of great wealth to themselves and to the Mother Country, fell on evil days, its struggles culminating in the latter part of the last century and the early part of this, its extinction being almost imminent prior to the relief afforded by the Brussels Convention, which coming into force in September, 1903, limited the malign influence of bounties given to European beet sugar; these bounties prevented the proper investment of British capital in the industry, and the development to the full of the British colonial sugar industry. The effect was evident during the late war when the Mother Country was sugar-starved to a dangerous degree, when the cost of sugar was alarmingly great and the country suffered seriously from its dependence on foreign-grown sugar and the cutting off of supplies of an article of food, an article not of luxury, but of prime necessity. These conditions of restricted supply led to wild speculation and resulted in a dangerous state of instability which, causing fortunes to be made and lost, was highly detrimental to the industry on account of the uncertainty created in the minds of the growers and manufacturers

sugar, and of the capitalists on whom the industry is dependent. At the present moment, there is some appearance of stability as regards British colonial sugar and it will be well for the Empire at large if this stability is effective and the developments ensue which it is calculated to foster, though it remains to be seen what action the present recently elected Parliament will take in this connection. While this question of the stability of the sugar industry is of vital interest to the West Indies, it is of no less vital interest to the Empire and it would be of general benefit if the people of the Mother Country could really understand the fundamental facts relating to sugar and the importance of the sugar supply to them. Unfortunately, sugar has ever been the sport of politics and it seems likely to remain so.

Since the holding of the last Conference, the World's position as regards sugar has been materially changed by the developments taking place in Cuba. Formerly, the price of sugar was largely determined by the supply derived from Germany and Austria. In 1903, the commercial reciprocity treaty between Cuba and the United States became effective, whereby Cuba obtained a preference in United States' market of 20 per cent. of the duty levied on sugar from foreign countries; this greatly stimulated production and led to the investment of enormous sums in improving the sugar factories, this development being mainly directed and controlled from the United States. During the five years from 1902-3 to 1906-7 the annual output of sugar from Cuba averaged 1,330,000 short tons; during the next five years 1907-8 to 1911-12, it was 1,748,600 tons and from 1912-17, 3,142,500 tons, while the average for the five years, 1917-8 to 1921-2 was 3,904,800tons, the amount for 1922-3 being estimated at 4,000,000 tons. With this enormous production and the immense reduction of the European beet sugar, Cuba now commands the World's markets. A striking instance of the effect of the careful directing and fostering of production by fiscal authorities.

Sugar interests have not, however, been neglected in the British West Indies: since the holding of the conference in Jamaica much progress has been made in regard to the manufacture of sugar and it can now be claimed that these colonies possess sugar factories whose work will compare most favourably with those situated in other parts of the world: their recovery of sugar from the cane is somewhat less than that of the Hawaiian factories, for the effect of American protective tariff makes it remunerative to aim at recoveries which would not prove profitable without the incentive so created, but the British West Indian factories now compare favourably with those of Java, Cuba, Porto Rico and other important centres of production.

Valuable work has also been done in the British West Indies in relation to the sugar cane itself and reference to the principal features of this will be made during our session: many new and valuable varieties of sugar-cane have been produced and much has been done in the control of pests and diseases, new botanical studies have also been instituted, and these should ultimately be fruitful of results.

The condition of the West Indian Cacao industry is causing grave concern; the dominant factor being the enormous increase in production mainly on the part of the Gold Coast Colony, and the consequent depression in price. As regards price, it yet remains to be seen whether it will be possible for the Gold Coast and other West African colonies to produce cacao profitably at prices lower than those with which West Indian growers can compete: cost of production is likely to increase in West African colonies as the industry expands, and more money and

effort have to be expended in maintaining the plantations and bringing the crops to market, while there is reason for hoping that West Indian costs of production may be lowered by more intensive cultivation, the elimination of poor types of trees and the control of pests and diseases, all of which may be hoped for as the outcome of the work and teaching of the Agricultural Departments and the activities of the estate owners. Furthermore, as the outcome of research and investigations in plant-breeding there are grounds for hoping that it may be possible to establish in the British West Indies the cultivation of special types of high class cacao which will be in favourable demand by the manufacturers and remunerative to the growers. The West Indies are favourably situated for experimental work in plant-breeding bearing on the production of new types of cacao, or the propagation of known types of established repute, provided that means are made available for the prosecution of this work, which could, and should, engage the activities of the research workers of the Imperial College of Tropical Agriculture. These are matters which may well form the basis of discussion and exchange of thought during this Conference.

The Fruit industry of the West Indies finds its chief development in Jamaica, with its important trade in bananas: this industry, while not without its difficulties, has been of the greatest service to this Colony and has done much to maintain its prosperity. Nearly 60,000 acres are reported to be under banana cultivation in Jamaica, the export of fruit being approximately 10,000,000 bunches having a value of over one and a half million pounds sterling.

At the present moment, considerable attention is being given to the prospects of establishing a banana industry in other parts of the West Indian colonies, notably in Trinidad, Grenada, St. Lucia, St. Vincent and Dominica. The possibilities in regard to British Guiana also have consideration. Certain difficulties have to be faced in regard to the industry in these new localities: some of these difficulties have reference to the commercial, as distinguished from the agricultural, aspects of the problem; they have to do with the shipping facilities, the provision of ships fitted with the requisite means for safely bringing bananas to market, and with the selling aspect of the business. Individual effort is incapable of solving the problems presented in this respect; co-operation and combination are essential. I hope that during this Conference there will be free interchange of ideas on these subjects and the development of proposals which may tend to solve the difficulties presented and help forward the proposal to develop a banana industry in the other British West Indian colonies: the scope for such a trade, particularly with the United Kingdom, appears to be such that Jamaicans need not fear that hurtful competition would arise: further development of the British and European Trade might be generally helpful.

The agricultural aspects of the development of the banana industry also presents difficulties, particularly as regards new districts. There is the lack of familiarity with the cultivation and handling of the fruit and there is the menace of pests and diseases, particularly of Panama disease. This disease is present in some of the new districts into which it is desired to introduce the industry but it is not known to exist in some of them. It is a matter for consideration whether the disease can be kept within defined areas in countries in which it is known to exist and whether it can be so controlled as to make it safe to embark on the enterprise.

These matters are included in our programme for discussion from

which useful information capable of early application in developing the industry may be forthcoming. I may here briefly state that interesting, and what I trust will prove important, investigations with respect to bananas have already been begun at the Imperial College of Tropical Agriculture: these investigations have their object the critical study of Panama and other diseases of bananas and also critical botanical studies concerning the banana plant with a view to ascertaining the facts relating to diseases in the hope of finding means for their control, or the production of varieties of bananas resistant to these diseases. These investigations which will be described at length include the getting together of a collection of varieties of bananas for study and, what constitutes a new line of work, the endeavour to produce new bananas from seed, in the hope that some of these may be resistant to disease and acceptable to the consuming public. The extent to which the work has progressed and the degree of success already attained in raising seedling bananas and other aspects of the work will form the subject of communications to this Conference.

Since the holding of the Conference in Jamaica in 1907, the development of a West Indian cotton industry has been a matter of some significance. The story is one which might with interest be told at length, for it is a striking example of the introduction of a new industry in which an alarming number of difficulties and hazards were encountered, and successfully dealt with by the combined efforts of planters, merchant-brokers, spinners and scientific advisers. As the outcome, pure strains of Sea Island cotton have been introduced into several islands and maintained there; the significance of which those engaged in cotton production will appreciate; at the same time a formidable series of pests and diseases has been overcome or controlled as the result of long and patient study on the part of the scientific officers concerned, backed by the agricultural officers and the planters themselves. Cotton is now grown on a community basis, the only way in which cotton growing appears possible in these islands, and has become of fundamental importance to the Islands of St. Vincent, Montserrat and Nevis, and of material assistance to St. Kitts Antigua, Barbados and the Virgin Islands.

Unfortunately, owing to the commercial depression and the cessation of the demand for luxury articles, for the manufacture of which Sea Island cotton is largely employed, the amount of Sea Island cotton produced in the West Indies now exceeds the requirements of the spinners: large stocks remain either unsold or locked away in the warehouses of the fine spinners: consequently, consideration is being given to the introduction of other types of cotton. It is worth pointing out that the production of the best types of Sea Island cotton now rests almost entirely with the West Indies: the invasion of the Sea Island cotton-growing districts of the United States by the Mexican Boll Weevil has made the growing there of this type of cotton no longer profitable or possible. The preservation of the Sea Island cotton industry in the British West Indies, is therefore, more than a matter of local interest, for, in the event of the revival of fine spinning in England reliance will have to be placed on supplies of fine cotton from the West Indies, and this revival would be seriously hampered or made impossible if this source of supply disappeared.

The cultivation of coconuts has now assumed importance in several parts of the British West Indies and appears to be capable of considerable expansion. Much remains to be done with respect to the study

of the requirements of this crop as regards cultural methods, manuring, and the control of pests and disease though some progress has been made along these lines: an important step consisted in the discovery of the nature and cause of what is now known as red-ring disease, a disease which formerly was confused with what is known as bud-rot, or with a hypothetical root disease. this disease, only recently recognised, is now found to be wide-spread and to be the cause of great destruction in parts of the West Indies and Central America. While the cause of the disease is now known, its nature appears to preclude the hope of applying any direct cure or remedy; relief is to be looked for in preventive measures, in framing which a complete knowledge of the causative agency is of the first importance: information will be forthcoming on the recent aspects of this disease and the scientific work relating to it.

There appears to be scope for further development in the erection of oil mills for the production of coconut oil and coconut cake, to replace, at least in part, the exportation of copra. The production of a considerable quantity of coconut cake might prove of service in several aspects of stock-raising, including the raising of milking cattle and pigs.

Besides the industries of fundamental and general importance, other industries may be mentioned.

The cultivation of rice assumes importance in British Guiana and Trinidad; there is the production of limes and lime products, a business of some magnitude in Dominica, Montserrat, St. Lucia, Trinidad and other islands, the growing of nutmegs, mainly in Grenada, but also to some extent in other islands, the cultivation of coffee, of fibres, of rubber and several other crops all of which engage attention; matters relating to some of them will be discussed during the Conference, as far as time permits, but it is expected that they will form subjects of interchange of views and information between the delegates during the time that they can come together in the interval between the sessions of the Conference.

In reviewing the economic situation as developed since the meeting of the Conference in Jamaica in 1907, two salient features strike me as significant and important: one is the marked developments that have taken place in the manufacture of sugar in the British West Indies, during the period, in consequence of which the manufacture of muscovado sugar with imperfect mills and wasteful methods has become a thing of the past, the British West Indies now, as I have already stated, possessing adequate modern machinery through the operation of which sugar is manufactured in a thoroughly efficient, economical manner and which permits of further improvements and developments being undertaken, whereby the industry may be kept abreast of the times, or indeed may occupy a prominent forward position.

The other development of much economic importance is the establishment in the British West Indies of a substantial cotton industry which has profoundly altered the agricultural and economic outlook of several islands, notably St. Vincent, Montserrat and Nevis which are now largely dependent on cotton growing for their existence, at the same time other islands, such as Barbados, St. Kitts, Antigua and the Virgin Islands find in the cotton industry a useful subsidiary industry of considerable service.

A little consideration will show that these two developments are of significant importance in that they have beneficially changed the outlook of whole communities and that they are the outcome of long-continued economic and scientific investigations: these developments

would have been impossible in the period anterior to the establishment of scientifically directed Departments of Agriculture. While they have proceeded so gradually as to appear in the nature of natural developments, the forces which underlay and moulded these developments should not be overlooked.

Imperial Department.

In his Presidential Address to the Conference of 1907, Sir Daniel Morris devoted a section to the consideration of the future of the Imperial Department of Agriculture, intimating the intention of the Imperial Government progressively to diminish the grant for its maintenance and pointing out the functions of the Department and the desirability that it should be maintained. Many of you are familiar with what has taken place since then, how the Imperial grant was progressively reduced until in 1913 contributions to the several West Indian Colonies ceased and the grant was limited to the sum necessary for the maintenance of the central establishment in Barbados: this latter part of the grant was continued until March 31, 1922, when the Department was amalgamated with the Imperial College of Tropical Agriculture, a progressiveiy diminishing Imperial grant being promised up to the year 1926-7, when, under existing arrangemen's. Imperial assistance to this Department ceases.

Time does not permit of the discussion in this address of the functions performed by the Department during the past twenty-four years, or of the services which it has rendered to the Colonies where its influence has been felt. Some of the changes which it has assisted in establishing have become so interwoven into the work and administration of these Colonies that the part played and the support given by the Imperial Government and the Department are in danger of being forgotten. However, permanent good will result if these Colonies now recognize that many of the functions inculcated are essential to the welfare of agricultural communities, and administration so proceeds that these functions remain undisturbed or are expanded. The scientific body assembled at the College should be of great service; furthermore, the researches and investigations there conducted should prove stimulating throughout the region, and be of wider range and greater importance than was possible at the hands of the Imperial Department as formerly constituted.

Agricultural College.

At this point reference to the foundation of the Imperial College of Tropical Agriculture is natural. For many years, there had been recurrent demands for the establishment of an Agricultural College in order that regular instruction might be given in matters pertaining to tropical agriculture. Numerous Agricultural Colleges had arisen in England, Canada and the United States, the stimulating influence and success of which caused agriculturists and land owners in the tropics to feel that similar success would attend the establishment of a tropical Agricultural College. Futhermore, the need for a tropical College seemed the greater, seeing that, while much teaching has taken place with reference to the agriculture of temperate regions, little had been done in this connection in the tropics. At the same time, the world's dependence upon the products of tropical Agriculture is growing and

the need for systematic teaching correspondingly increasing. It would be tedious to attempt to enumerate the many attempts to secure such a tropical College or to refer to the many schemes put forward, suffice it to say, that in 1921, as the outcome of strong representations made to him, Lord Milner, then Secretary of State for the Colonies, appointed a Committee to consider the desirability of establishing a Tropical Agriculture College in the British West Indies and to advise generally upon the subject. The Committee reported favourably and in September of that year, the College was duly incorporated. As the outcome of the arrangements made with the Colonial Office, the Imperial Department of Agriculture was amalgamated with the College and the headquarters removed to Trinidad, where the College was opened in provisional buildings on October 16, 1922, by His Excellency Sir Samuel Wilson, K.C.M.G., the Governor of the Colony. An opportunity will be afforded during the session of the Conference to refer at greater length to the aims and objects of the College, to the financial basis on which it is supported and to the work which has been already accomplished. It should, however, be emphasised that not only is teaching a leading part of the work of the College, but great stress is laid upon the function which it is desired that the College should fulfil as a centre of scientific research.

The problems of tropical agriculture are numerous and to a large extent differ remarkably from those of temperate regions, they have been investigated only to a small extent; their proper investigation is essential as the basis of correct teaching, not only in relation to College classes, but in the wider information and instruction to be handed on to the working agriculturists for guidance in the management of the plantations and their crops and for the development of new industries and the expansion of old ones. Given adequate support, I feel well assured that the Imperial College of Tropical Agriculture will be able to give sound training to the men to be engaged in agricultural work in the tropics right round the world, whether this work consists in the actual growing of tropical crops, or directing the scientific activities which this work demands, or in manning the Agricultural Departments whose functions it is to ensure the development of the Dominions and Colonies and, in addition, I feel equal assurance that the College will constitute a centre of scientific activity and research from which new knowledge will steadily emanate to the lasting benefit and development of tropical agriculture in its widest sense.

Mr. W. S. E. Barnardo (Trinidad): Your Excellency, Lady Probyn, ladies and gentlemen: On behalf of the delegates to this Conference, I have great pleasure in moving a vote of thanks to His Excellency the Governor, and the Government of Jamaica, for the hospitality they are extending to us, and the cordial welcome they have given us. I feel sure that as His Excellency has pointed out, you will agree that only good results can come from such a Conference as this. We have again, as I have said before, to thank both His Excellency and the Colony of Jamaica, for giving us the opportunity such as we are having at this Conference (applause).

Hon. J. T. De La Mothe (Grenada): I beg to associate myself with the remarks made by my colleague, Mr. Barnardo, from Trinidad. I have great pleasure in doing so, especially when I remember that your Go-

vernor, I might say, had this training in the little island of Grenada, from which I come. That the Conference will be of very great use is self-evident. I would not have taken the trouble to come to the island if I did not realize from the beginning that the Conference would be of great benefit for the West Indies –not only to my own colony, but to the colonies generally. I beg heartily to associate myself with Mr. Barnardo, in thanking the Government of Jamaica for the preparation and trouble they have taken over this Conference, and for extending such a welcome to us here to-day (applause).

Sir Francis Watts: You have heard the resolution moved by Mr. Barnardo and seconded by Mr. DeLa Mothe. I now put it before the meeting formally. Those in favour please signify in the usual manner.

The resolution was carried unanimously.

Sir Francis Watts: Your Excellency, I have great pleasure in tendering to you the resolution which you have heard spoken to by my colleagues from the other islands, thanking Your Excellency for the cordial manner in which the Conference has been welcomed here, and the efforts made to make it a great success. That, sir, I think, concludes our formal business, and I think we might now do something towards settling our programme for to-morrow. As you are aware, we only arrived a few minutes ago—it seems to us like as few minutes ago—and we have had a considerable rush. Now we will have to steady down and arrange our week's work.

The Conference adjourned until 11 a.m. on Tuesday, January 29th, 1924.

SECOND DAY, JANUARY 29th, 1924.

Under the Presidency of Sir Francis Watts, K.C.M.G., the Agricultural Conference resumed its sitting at the Ward Theatre on Tuesday, January 29th, 1924, at 11 a.m..

There was a large attendance of delegates. Among those on the platform was Sir Arthur Shipley. The Hon. Colonel H. Bryan, C.M.G., Colonial Secretary of Jamaica, was among those present in the audience.

The President. We have no time to lose and I propose that we start right away with our programme. But before we begin, I want to point out that it will be desirable for us to go on with our programme as the events arise. Thus, if the papers that are presented to us this morning are finished before the time for the mid-day adjournment, I propose that we go on with other business, because we should get through our work as reasonably expeditiously as we can without any undue hurry. With these remarks, I will now ask Captain Hill to give us his paper on "The Imperial Aspects of Tropical Agriculture." Captain Hill, as most of you are aware, is the Director of the Royal Gardens at Kew, and Kew as we know, has a thoroughly Imperial outlook in regard to tropical agriculture. We may regard Kew as the mother of tropical agriculture.

Captain Hill then read his paper as follows:—

"THE IMPERIAL ASPECTS OF TROPICAL AGRICULTURE."

By A. W. Hill, F.R.S., Sc.D.

"It has been suggested to me that I might contribute a short paper to this Conference on the part played by the Home Country in the develop-

ment of Tropical Agriculture and as the Institution, which I now have the honour to direct, has been so intimately connected with Tropical Horticulture and Agriculture in the long course of its history, I hope my remarks may be deemed of sufficient interest to warrant my addressing the Conference

"In its earlier stages, Botanical and Agricultural enterprise in the Tropics was so linked with the Royal Gardens, Kew, that a history of the latter is in many of its aspects the history also of the earliest stages of Tropical Agricultural endeavours.

"We can look back, I think, to Sir Joseph Banks, who was virtually the first Director of Kew, then a private possession of the Crown, as the man who first appreciated the vast possibilities of our tropical possessions, and realised the necessity of establishing an institution in the Mother Country which could act as the centre from which help and counsel could be given to the Botanical establishments which were springing up as the result of private enterprise in the colonies.

"To the West Indies the credit is due of having established the first of these Colonial Gardens or Botanical Stations in the island of St. Vincent in the year 1756; and Jamaica was not long in following St. Vincent's lead, for as no doubt is well known here, a Botanic Garden was established in this Island in 1773—just over 150 years ago—and though the original garden does not now exist, Jamaica, thanks to Sir John Peter Grant and Sir William Hooker, has two fine gardens at Hope and Castleton, as well as the station at Cinchona, and has continued to maintain her Botanic Gardens down to the present day.

"It was to Kew and the men trained at Kew that the Colonial Gardens looked for their Curators and superintendents and most of the early, and nearly all the later, Curators have been sent out from Kew, and so that link between the Home Institution and the Colonies which has proved of so much value to the departments overseas has been maintained.

Mr. Joseph Chamberlain in his speech in the House of Commons, August 2nd, 1898, referred to the work of Kew in the following words: "I do not think it is too much to say that at the present time, there are several of our important Colonies which owe whatever prosperity they possess to the knowledge and experience of, and the assistance given by, the authorities of Kew Gardens. Thousands of letters pass every year between the authorities at Kew and the Colonies, and they are able to place at the services of these colonies not only the best advice and experience, but seeds and samples of economic plants capable of cultivation in the Colonies."

I need not give in detail the names of the pioneers in botanical enterprise, many of whom were originally collectors sent out from Kew; but I should like to remind you that among the earliest of the Curators sent out by Sir Joseph Banks from Kew to the West Indies were George Caley, who was sent to St. Vincent in 1816, and David Lockhart, who was the first superintendent of the Trinidad Garden which was founded in 1817.

In the early days, the economic products which were of interest to the West Indian Colonies were mainly the sugar cane and spice plants. Sugar cane was introduced, we believe, by Colombus about the year 1493 to the West Indies, and it was first cultivated by the English in Jamaica in 1660. The Bourbon cane was introduced in 1794.

The previous year (1793) Captain Bligh had reached Port Royal with breadfruit trees, an enterprise which had been encouraged and suggested by Sir Joseph Banks.

A few years earlier, in 1771, Mr. Baker introduced the tea shrub to Jamaica under the name "Bohea Tea" and a second introduction of "Assam Tea" took place in 1749-50, when plants were sent to the Bath Gardens from Kew. Then again in 1808, a Wardian case containing 600 plants was sent out to Jamaica and these and subsequent consignments sent out by Kew were planted at Cinchona, where the Cinchona plants sent were already established. Nutmegs, pepper and cloves were among the early spice introductions. Nutmegs were first brought to Jamaica in 1782 by Lord Rodney and were re-introduced in 1788 together with cloves and Black Pepper by Dr. Marter.

In addition to these economic products, the Home institution has been of assistance to the West Indian Colonies and especially Jamaica in the introduction of the best type of tobacco, which is now a flourishing industry, coffee, pineapples, Para rubber, cocoa, teak, bananas, onions, mangosteens and many others at present of minor importance, but which in time to come may prove of considerable economic value.

Enough has been said on the subject of plant introductions to show that a central institution to which the Colonial Gardens are linked by close ties can be of great benefit and assistance, since, being in correspondence with all parts of the Empire, and having a scientific staff acquainted with the economic plants of the world, those directing the affairs of the Central establishment are able to suggest to the Colonial Departments plants worthy of their attention, or lines of research which might be followed with advantage. Assistance can also be given to the colonial institutions by sending out new or improved varieties of plants of economic value.

Within the last few years, consequent on the general growth of scientific knowledge and the interest that has been awakened in the botanical and agricultural possibilities of our overseas possessions, a great change has come over our methods of dealing with the questions which are broadly included under the term "Tropical Agriculture." From the early and original Botanic Gardens and stations, which were more or less dependent for their welfare on the Home institution at Kew, Agricultural Departments, serving wider interests, have gradually been evolved so that now in almost every British Colony there is a definite Agricultural Department presided over by a Director of Agriculture, who includes among his staff in the more complete departments, a Plant Pathologist and an Entomologist, an Agricultural Chemist, a Plant Breeder, or Economic Botanist, and several Agricultural Inspectors and Instructors.

This fuller development of agricultural investigation and research overseas has corresponded with the great advances which have taken place in scientific knowledge at home in our Universities and Colleges, and in the sympathetic attitude which Government has taken towards scientific matters.

To this sympathetic attitude of Government was largely due the foundation of the Imperial Institute, which has done useful work in the chemical investigation of economic products and in the examination of fibres, cotton, drugs, etc., demanding expert technical knowledge. More recently, we have seen the establishment of the Imperial Bureau of Entomology and of the Imperial Bureau of Mycology, and I think it is hardly necessary for me to point out to this gathering how valuable are the services which have already been rendered to our overseas possession by these two important Bureaux, especially as they are both represented at this Conference. The existence of these two Bureaux

I think, demonstrates remarkably clearly the need of a Central "Court of Appeal" at home for our tropical scientific departments, and though they deal more especially with the insect and fungus pests injurious to the crops on which the welfare of our colonies so largely depend, they serve to illustrate the general proposition which I am attempting to put before you.

Speaking more particularly of the Bureau of Mycology as a member of its comm ttee of management, its two main activities are (1) the accumulation of information on all matters connected with the diseases of plants and (2) the identification of specimens of injurious fungi.

It is clear that neither of these functions could be performed except by a central institution at Home closely in touch with every one of our tropical colonies and Dominions, and with those belonging to other countries and furnished with all the literature bearing on the subject. To fulfil the first of these functions means the receiving and careful digesting of the publications on pathological fungi from all over the world, a task which no single Colonial Agricultural Department could ever hope to undertake.

To carry out the second function—the identification of pathogenic fungi—a great Herbarium is needed, and the Bureau, being established at Kew enables it to carry out this function in the most efficient manner.

Before the Bureau came into being Kew itself afforded considerable assistance to plant pathologists the world over, but the smallness of our mycological staff did not permit of the work being done with that completeness and efficiency which is so essential in difficult questions of disease, where such immense interests are at stake. But the point is that it is only at home that is possible, with the fullest facilities available, to review the problems of disease as a whole and with a complete set of specimens for reference –as at Kew for fungi, or the British Museum for insects, to furnish our overseas possessions with the information and assistance which should enable them to combat and overcome the problems with which they are confronted in the cultivation of their economic products. I need only mention two serious plant diseases at present engaging the attention of the West Indian Agricultural Departments namely the Panama Disease of Bananas and the Wither-Tip Disease of Limes, to illustrate what I wish to point out.

There is a further aspect of the Home institutions, the importance of which I think hardly needs demonstration whether we are considering the Bureaux, the Royal Botanic Gardens, Kew, or the Imperial Institute, and that is that they are the places to which workers overseas naturally come, when home on leave or on duty, to continue their studies, and to meet with the research workers at home. Not only can they tell the worker at home more exactly the nature of their problems, but they can receive from them what is of so much value, fresh light, help and encouragement which should enable them on their return to set about their work with renewed energy, and clearer insight. The stimulus and advantage of being in co-operation with an authority at home, who is able to regard the problem with possibly a wider outlook and a fuller appreciation of its nature, from his knowledge of its relation to similar problems in other Tropical countries, hardly needs demonstration.

Then, again, with regard to my own particular sphere, I may refer to one of the many problems which can only be solved by reference to Kew, and which affords a good example of the value of our Herbaria, Library and Museums. The chicle gum tree of Honduras is a tree of economic importance and it seemed desirable to introduce it to culti-

vation in Dominica. Seeds were introduced from British Honduras and the trees have grown and flourished, but unfortunately they yield no gum. We accordingly sent out to British Honduras and Dominica for specimens and have received a good deal of material of chicle trees. We now find that there appear to be at least four different species passing under the name of *Achras sapota*, and owing to the lack of proper correlation of the gum-yielding trees with leaf specimens, we are not yet able to say which is the true chicle, but it is quite clear that the Dominica trees are not those of the species which yields the chicle gum of commerce.

But Kew, being as it is the store house of the plants of the world, and more especially of the Empire, sets out to perform wider functions on similar lines. The Herbarium at the Royal Botanic Gardens now contains between three and four million dried specimens and the annual additions to our Herbarium collections number some 30,000 sheets. As long ago as 1865, Sir William Hooker, with remarkable foresight, drew out a list of the floras of the different parts of the Empire, which he considered should be prepared at Kew. His estimate of the number of volumes which would be required was a remarkably accurate one, and many of the volumes proposed nearly 60 years ago, have now been published. Time, however, and the growth of our knowledge, has naturally rendered much of the earlier work inadequate, so that while a few of the projected floras still remain unwritten, others urgently require to be revised and re-written.

This work can only be done at home where the type specimens are preserved, and without taking you on a survey of the British Empire, I can well illustrate my remarks by referring to this particular portion of the Empire where we are now meeting. The flora of the West Indies, which was one of the earliest of the Kew floras projected by Sir William Hooker, now urgently needs revision, as botanists in these islands fully realise, and hope at no distant date this may be undertaken. Then, alas, the flora of the British Guiana, which is a remarkably rich one, the flora of British Honduras, and the flora of Trinidad and Tobago have not yet been started, though they were included in Sir William Hooker's scheme. The *Flora of Jamaica*, happily is now nearing completion in the competent hands of Mr. Fawcett, to whom Jamaica is so greatly indebted for his valuable services. This fine work, which has been compiled from the resources of the Herbaria at the British Museum and Kew, has been rendered all the more valuable by Mr. Fawcett's intimate knowledge of the plants growing in Jamaica. The successful progress of this work at home, and I hope, also in this Island, and its preparation, serve to show that we are rightly jealous of our West Indian Colonies and have no desire to see them become an appanage of the U.S. of America, either in matters botanical or agricultural.

I hope it may be possible in the near future for Kew to commence the long delayed Flora of Trinidad, the preparation of which has been hindered by lack of funds and adequate staff, and that we shall not have to turn to our Botanical friends in the United States for the compilation of the flora of one of the botanically richest and most interesting of our West Indian possessions.

Science, happily is international, and I do not for one moment grudge all that we have learnt from the activities of the botanists of the United States, but I do feel very strongly that the providing of information about the floras of the different parts of our Empire, and the making available all we know and can discover of their economic possibilities, is a patriotic duty which it is incumbent on the headquarters of botanical enterprise of the Empire to carry out.

I may, in passing, mention that the West African Governments have been so fully alive to the importance of an accurate knowledge of their floras in connection with Agricultural and Botanical enterprise, and to the help that Kew alone can give, that they have provided us with an assistant for West Africa to enable us to prepare a Handbook Flora of West Africa, and should similar financial assistance be forthcoming from the West Indies, I can assure you that Kew would at once set about the preparation of the Floras which are so urgently needed in this portion of the Empire.

A correct and up-to-date flora is no mere academic work useful only to the professional Botanist, but it is essential for the commercial development of the economic possibilities of a country. Until we can correctly identify the trees, shrubs and herbs of a region, it is not possible to supply information as to the plants likely to be of value to the agriculturist or the horticulturist. The collections in our Herbaria and Museums of Economic Products enable us to supply full information both to scientific and to commerical enquirers as to the sources of the innumerable products furnished by plants for our use and convenience whether as articles of food, of construction, of application to the Arts, of medicine, or of curiosity. We also are able to appreciate not only how much we have already discovered, but also how little we still know, of the extent to which herbs, shrubs and trees contribute to our necessities, comforts, and our numberless requirements.

It is in this latter direction, where so much has still to be learnt, that the Colonial workers can assist in their turn the Home Institutions by providing it in the fullest manner possible with the materials which will enable the still unknown wealth of their vegetable resources to be accurately determined.

I have been speaking more especially of the flowering plants in connection with the work of Kew, but it must not be forgotten that the lower plants—Fungi, Algae, etc.,—equally claim our attention. With regard to the Fungi, I should like to allude to the excellent work "Diseases of Crops Plants in the Lesser Antilles" which has recently been written by Mr. W. Nowell, a treatise which could only have been prepared to be of any real value by a Mycologist working in the islands in association with workers at home for the exact determination and description of critical species. But, as with the flowering plants so with the Fungi there is a great need of a handbook of the West Indian Fungi which must be compiled at the Home Institution, where exact determination and description can be carried out, and our Mycologist, who, thanks to the President, was able to spend some time in Barbados and Trinidad in 1921, is now engaged in the preparation of as complete a West Indian Fungus Flora as may be possible, on systematic lines with keys and possibly line figures, which should be invaluable to Mycologists in these Islands.

We should welcome as much additional material at Kew representing the fungus flora as can be sent to us to supplement our already rich collections, so that the work in preparation may be of the fullest value. I have endeavoured to show that institutions in the Home Country being in close touch with the world at large and being the repositories for the collections of plants, specimens, both of Phanerogams and Cryptogams, and of Zoological material, can still assist the Agricultural and Forestry Departments overseas as they have so materially done in the past: but I fancy it may have already occurred to some of you to ask whether, after all, with recent developments, I am not assuming too much, and that, in the West Indies in particular, now that the Imperial College of Tropical Agriculture has been so happily established, there is

little need to look to Kew or to the two Imperial Bureaux any longer; or the question may have been put in some such form as "What good are we going to get out of the new Imperial College of Tropical Agriculture?"

As Sir Arthur Shipley, the chairman of the Governing Body, is fortunately with us, and will have something to say on the aims and objects of the College, it would be out of place for me to enlarge on the subject.

I need only say that while at home with our great storehouses of material, we can assist in the matter of accurate determination, etc., and correlate information from many sources, it is the role of the College not only to train men to develop the agricultural resources of the Empire, but also to carry out those researches in Tropical botany, entomology, chemistry and agriculture which can only be successfully undertaken in the Tropics.

The working out of these problems in Agriculture, Chemistry, Mycology, Genetics, etc., under tropical conditions, in co-operation with the authorities at home, together with the training of students, both junior and post-graduate, cannot fail to have a most important and far-reaching effect on agricultural progress throughout the Empire, and also to serve to strengthen those ties between the home institution and the Colonial Departments which it is, I feel confident, so essential to maintain. I may in conclusion allude to one further way in which Kew especially could render help to the Empire on Imperial lines. In my opening remarks, I referred to the early Kew collectors initiated by Sir Joseph Banks who were continued under Sir William Hooker when Kew became a national establishment

The practice of sending out these trained men to various parts of the world to study and bring home plants of interest and value, unfortunately ceased many years ago, but was continued by private enterprise, often with results of great value. I think, however that much still remains to be done in this direction, and that nothing but good would result could we persuade the Government to return to the practice initiated by Sir Joseph Banks. The functions of such 'plant collectors' in these latter days would be very different from those of the early pioneers, but I submit that were it possible—to take three concrete cases which affect these islands—to send trained botanists to study Bananas, Coconuts and Limes in different parts of the world, and to bring back the varieties most suitable for experimental cultivation and research, the value would be immense. At present, we at Kew, when we receive requests for bananas, possibly immune from Panama disease, or for Limes which are not subject to wither-tip, or for improved varieties of coconuts, can only write to the most suitable sources of supply and though we may succeed in obtaining material of value we do not know that we may not be doing really more harm than good by introducing at the same time, some insect or fungus pest to which the plant is subject, which may prove a serious source of danger in its new home. Could we, when the introduction of a new or improved variety or species seems desirable, send a trained botanist from headquarters to study the required plant and its possible physiological forms, its susceptibility to disease and its cultural possibilities in a new sphere, I feel that we should be doing something of real and permanent value. Such a function, which would be truly Imperial, should be performed by the Home Government and when it is remembered how vital the agricultural interests of our overseas possessions now are, I do not think

it too much to say that this service ought to be regarded as an Imperial Duty.

When one looks back over the long connection of Kew with the Colonies, its small beginnings and its huge developments, I am reminded of a beautiful passage in the Book of Ecclesiasticus: I came out as a brook from a river and as a conduit into a garden—I said I will water my best garden, and will water abundantly my garden bed, and my brook became a river and my river became a sea. (Applause.)

Captain Hill in emphasing some of the points brought out in the paper, said : No doubt you are aware of the chicle gum industry. I believe it is a matter of vital importance. There are some flourishing trees in Dominica, but when they come to chip these trees, they find that they have no gum. As a result of our enquiries, we find that in British Honduras, there are four trees which are supposed to be chicle gum trees, and the tree that is grown in Dominica may be one of these trees. This is one of the problems which we hope to solve before very long. There is another point, which is under investigation, and that is a certain fibre plant which comes from this part of the world and has been put on the market under a camouflaged name. I will not mention the name, because it will give the whole show away. We are going ahead on it by a side light and are trying to find out all about it. We are endeavouring to find out the source of this plant, by back stair means. And if there is any place where people have been exploiting this plant, and if we find out really where it comes from and exactly what it is, we may be able in a few months' time to tell anybody who is desirous of taking up this industry, all about it, and what it is worth. But if anybody wants to put money in a rather unknown enterprise, I would advise them to be cautious about the matter and wait for further information.

Now, with regard to the Panama disease of bananas, we know where the bananas grow and we know that there are pests. And if you write to these places you may get bananas that you want, but you may get bananas that are diseased, and then there will be more harm than good. And the same thing applies to limes and to coconuts. In the matter of the Panama disease, I have advised the Colonial Office that at the present time it would be quite unwise to get these specimens.

The President: It is quite open to us to have a discussion now on Captain Hill's paper, but the discussion will have to be confined to members of the Conference, unless special arrangements are made for any gentleman, who is not a member of the Conference, to take part in the discussion. If any member of the Conference now wishes to raise any point relating to the paper of Captain Hill, he may now do so.

Mr. S. S. Stedman: Kew means a lot to us. I am afraid a great many of the delegates here do not know what Kew means to us. And if we were to get a little more explanation from Captain Hill, as to really what Kew means to us, I think they would be able to appreciate it better. I know what it means, but I think the majority of the delegates here, do not realise what Kew means to the Empire. We want to know about the work of Kew.

The President: Does any other member of the Conference wish to ask any question, or raise any point in regard to the matter now under discussion ? [No other member spoke.]

Captain Hill: I am afraid I have been asked to let a large question. I will try in a few words to say something as to what Kew is. Kew

comprises four separate departments. There is a portion which is known to every resident in Great Britain, and that is the garden proper which consists of 300 acres with a large number of green houses, one of which has a temperature of something like this building where we are now assembled. In these gardens and green houses we attempt to grow all the plants that it is possible to grow in Great Britain, economic or plants of beauty and interest, and it is our endeavour whenever we grow any plant of particular interest to distribute it to the various colonies. And in that way, the cocoa went to Africa and it also went to Trinidad. Recently we sent a remarkable oil producing plant to Dominica, and one of our famous introductions from Kew was the introduction of Cinchona to India, and as a result of that it is possible to get quinine at every post office in India, at a very small cost indeed. Another industry in which Kew has done something is Para rubber, which has been sent out from South America. Then there are our Museums where we have every economic product which we can secure; we arrange for specimens to be sent to us for identification, and it is very seldom that we are baffled in our determination of any plant. We have four Museums—one for British forestry, one for Colonial forestry, and the other two are devoted to matters in Great Britain. Then there is our big Herbarium and library, and this is part of our domain which is really most valuable, but which the public do not see, because it is rather too valuable to allow the public to come in and disturb.

In our Herbarium we have thirty botanists at work, and then in addition we have our laboratory where a great deal of work is being carried on. I do not know if I have answered the question that was asked by Mr. Stedman. The only thing I can suggest, which would be a proper answer to the question, is that the delegates here should pay us a visit at Kew, and then they will be able to see for themselves (hear, hear).

The President: Dr. Hill, as far as the time that he had at his disposal would allow, has given us information as to the immense activities of Kew and the intimate manner in which they touch the whole of the tropics, and particularly the West Indies. He has shown us that the history of Kew is intimately woven with the history of the West Indies. I would like to say one thing. It has always appeared to me that the function of Kew Gardens appears to be like the function of a flywheel in a machine. It gathers up the energy of the whole of the apparatus and the work is carried on effectively all the time. Kew makes for continuity and it is the flywheel of agriculture in the Empire. I think we may thank Dr. Hill for his very able address and, of course, his paper will appear in the proceedings of this conference.

Mr. Bovell: I would like to express my appreciation, on behalf of the colony of Barbados, of the greatest services which Kew has rendered to the West Indies. Some years ago when we had a fungus on the sugar cane I took over to England certain specimens of the fungus, and they helped me at Kew in every way possible. The people of Barbados were very thankful to the authorities of Kew for the great assistance they rendered to me on that occasion.

The President: I will now ask Dr. Neave to give us his paper on "The Work of the Imperial Bureau of Entomology."

"THE IMPERIAL BUREAU OF ENTOMOLOGY."

BY

S. A. NEAVE, M.A., D.SC., F.Z.S., F.E.S.

When I was honoured with an invitation to attend this Conference to represent the Imperial Bureau of Entomology, I felt that the most suitable subject to put before you would be a discussion of some details of the work of the Bureau itself. This seemed particularly appropriate in view of the fact that Dr. Guy A. K. Marshall, C.M.G., F.R.S., the Director of the Bureau, was present at the West Indian Agricultural Conference in 1912 and on that occasion described the outlines of the work of the Entomological Research Committee. Though that body limited its activities to Tropical Africa, requests were then being made that it should extend them to other parts of the Empire. As a result, the Imperial Bureau came into existence in its present form in January, 1913. Its work has been gradually expanding since that date, the Imperial Entomological Conference held in London in 1920 having been unanimous as to the great importance of the Bureau being placed on a permanent basis.

Before, however, going into the details of the work of the Bureau, I should like to say a few words on the general subject of Applied Entomology, and also to emphasise the great importance to the British Empire of some central clearing house for insects and insect problems such as the Bureau provides. The basic work of such a Bureau must obviously be the collection and dissemination of all information likely to be of value to Entomologists throughout the Empire. Original research -except to a limited extent in the case of the systematic study of insects—cannot be part of its primary duties. So far, however, as research is concerned, the West Indies are extremely fortunate in possessing efficient local departments of Agriculture and also in the fact that the Imperial College of Tropical Agriculture, which I have recently had the pleasure of visiting in Trinidad, has been located amongst them. This College appears to me to afford you a unique opportunity of finding the solution of many of your agricultural problems; such problems are in a position to be attacked with the best possible prospects of success owing to the fact that the constitution of the College enables investigations to be conducted by a combined team of specialists. In the past, technical officers and specialists on subjects more or less connected with agriculture have been prone to carry on their work without reference to the point of view of their colleagues, often with unhappy results as regards their recommendations, and nowadays the entomologist or other expert in an Agricultural Department, if he is to be efficient, must have a good working knowledge of at least the principles of Agriculture.

The fact that you have at the Imperial College in Trinidad, a combination of experts closely acquainted with the crops that are grown in the West Indies and with the problems connected with them, represents in my view, the finest insurance policy against pests and disease of your crops, especially unforeseen ones, that it is possible to have.

But, for the reason that knowledge concerning insects and other organisms that are potential crop pests must be obtained in advance of their reaching that status, it is not possible in research work to draw any clear distinction between economic and non-economic problems. Many an isolated fact of apparently no economic importance has

subsequently proved to be a vital link in a chain of facts that have a far reaching practical value. Instances might be multiplied from all over the world where much might have been done to control outbreaks of insect pests with a minimum of delay if only more had been known beforehand as to their life history and distribution. To realise the importance of the points we have only to consider how it is that insects come to be pests of our crops. It is not difficult to show that this is entirely due to the action of man himself.

In order to make room for his own crops, man destroys wholesale large areas of virgin forest which are populated by a great variety of animals and plants living in a state of equilibrium. In the place of this, he often substitutes a single crop, with the inevitable result that he forthwith provides a vast new food supply for any insect that lives on, or can adapt itself to, the crop in question, and at the same time, he exterminates or drives away many of its competitors and natural enemies. Two lessons may be drawn from this—one, that large unbroken areas of a single crop, where no rotation is practised, inevitably offer special risks of severe outbreaks of pests, and secondly that, given the knowledge with which research will ultimately provide us, the potentialities of, and remedies for, a pest will be foreseen, and an outbreak will be able to be dealt with without delay whenever it may arise.

It seems to me that this desirable result can only be arrived at by a proper marshalling of our forces and by organising a satisfactory liason between them. We may be said to have four lines of defence. The first of these is the individual planter himself who carries out the recommendations of the second line, i.e., the local entomologist whose position may be likened to that of the general medical practitioner. Research and teaching institutions, such as the Imperial College in Trinidad, constitute the third line, and not only may be said to represent the specialists in medicine to whom members of the second line go for advice, but they are also engaged in helping to create the members of that line. Lastly, we have a central organisation such as the Imperial Bureau which, to change our metaphor from a medical to a military one, may be said to represent the Intelligence Section of the Imperial General Staff. The function of this, the fourth line of defence, is not only to help both the second and third lines with information and advice from the extensive sources available to it but to keep them informed as to the progress of the battle through the world.

To turn now to some details of the work of the Bureau. This is divided into two main sections (1) the identification of, and reporting on, the insect pests and the problems connected with them that are sent in from all parts of the world, (2) the publications.

The identification work is carried on at the head office of the Bureau at the Natural History Museum in South Kensington where the great National Collection of insects is available for comparison. In order to give some idea of the extent to which this work has grown, the following figures for the year ending 31st March, 1923, may be of interest:—the number of insects received was 56,000, and the number of identification lists sent out was 193 involving 6,268 specific identifications. The numbers for the year ending in March 1924 promise to be higher still and they will doubtless continue to increase. In this connection it must be remembered that the usefulness of the Bureau to any Colony is necessarily limited by the attitude of the Colony itself. In the case of those Administrations that do not maintain the services of an Entomologist, the use they can make of the Bureau is necessarily severely

limited. It must not be thought however that the help that the Bureau is willing to render is given only to official entomologists. It is much to be hoped in years to come that more individuals or companies planting on a large scale will employ their own entomologists or will combine to share the services of one and will thus be able to utilise the resources of the Bureau to a greater extent than is possible for them at present. The Bureau not only deals with noxious insects but with beneficial ones and a comparatively new branch of its work, which may have important developments in the future, is the exportation of parasites to various parts of the Empire. The work is carried on at the cost of the Bureau at the Rothamstead Experiment station under the superintendence of Dr. A. D. Imm. The chief parasites dealt with so far have been two Tachinid flies parasitic on the common earwig, and Hymenopterous parasites of the pear slug, all of which have been sent to New Zealand. It is hoped to send to Canada during the coming year some parasites of the wheat stem saw fly, a closely allied species of which occurs in England though it is not a serious pest. This work has, however, certain inevitable limitations due to climatic conditions and is therefore likely to be carried on chiefly for the benefit of those countries that have a temperate climate. None the less, it has recently been found possible to establish in Muscid flies in England some Hymenopterous parasites of tsetse flies from Nyassaland with a view to sending them out to Nigeria.

The Publication Office of the Bureau is at 41 Queen's Gate, a building owned and occupied by the Entomological Society of London. It is only a few minutes walk from the National History Museum and great advantage to all Entomologists is derived from the presence under one roof of the fine library of the Society, which is mainly systematic, and that of the Bureau which is chiefly devoted to the economic aspects of Entomology. The library of the Bureau, although only 10 years old, already comprises over 3,000 bound volumes and a vast number of reports and separates which are all catalogued and card indexed. These are all available for loan, though bound volumes are not usually sent abroad.

The chief work of the staff of the Publication Office is the publication of the *Review of Applied Entomology* which is published in two series, A. dealing with agricultural pests, and B, with medical and veterinary ones. This publication has grown steadily since it was first published in 1913, and the demand for it has also increased very considerably. The average number of separate abstracts published, which was about 1,500 annually for the first five years, rose for the next five years to about 2,000, while for 1922 and 1923 it has been about 2,450. These include many from Russia, publications on applied Entomology from that country being especially numerous before the Revolution and representing a literature on the subject almost unknown to English-speaking Entomologists. In producing this journal great efforts are made to keep it up to date so far as it is possible to do so, and practically every original received by the Bureau is abstracted and published in the *Review* within 6-8 weeks of its receipt. In view of the necessary delays involved in abstracting, editing printing and proof-reading it is hardly possible to improve upon this. Very great importance is also attached to the indices which it is essential should be very full in a journal of this character. The annual ones are published in June and July in the year following that of the volume to which they refer. It is also hoped to publish shortly a complete index to all the Arthropods in the first 10 volumes of Series B of the Review and to do the same for Series A at the completion of the 13th volume, a

separate subject Index to the first three volumes to that series having already appeared.

The other principal publication of the Bureau is the *Bulletin of Entomological Research* which contains original articles connected both with medical and agricultural problems. It is published in four parts a year and is now in its 14th volume. The Bureau also published in 1921 a summary of the Plant Pest Legislation of the Empire.

These publications are supplied free to all contributing Governments in proportion to their contributions and are also sold to the public at a nominal price which in no way represents the cost of production. Indeed, in the case of the *Review* it is very doubtful whether it could be produced at all on a commercial basis even if sold at a greatly enhanced price. Its preparation necessarily involves the employment of a considerable staff and the careful examination of a vast number of periodicals or series of reports (this number having risen of late years to well over a thousand) in all languages.

The Bureau has also recently undertaken the preparation of the "Insecta" part of the Zoological Record for which work it is at present receiving a subsidy from the Record Committee. This work is still only in an experimental stage, but it is hoped that it will be possible to carry it on concurrently with the other work of the Bureau and if possible, to bring its publication much more up to date than has been the case in recent years.

In concluding this brief review of the work and functions of the Imperial Bureau, I shall be pleased to give members of the Conference any further information in my power on points that I have not made clear or have not alluded to. (Applause.)

I would like to say with regard to the economic establishment of entomology that when Dr. Marshall went to Barbados in 1912, he was shown some of your hard-back beetles which had done great harm to the sugar canes. He said it was the same beetle that they had got from Mauritius and he took home specimens of that beetle and then found it was the same beetle that had come from Mauritius. But for that little fact of systematic knowledge, all that useful work done in Mauritius would have been lost. I think it is impossible for any man to draw a distinct line between the economic and the non-economic.

The President:—I would now ask any member of the Conference to ask Dr. Neave any further questions on matters connected with his very interesting paper. Dr. Neave has told us how the Bureau is operating and what it does and what it hopes to do.

Mr. Bovell—In confirmation of what Dr. Neave has said about Mauritius, I may mention that a gentleman has just come to Barbados and he has told us that they are keeping the pests in check in Mauritius.

Prof. Harland—I would like to say that from my own point of view, I feel very strongly the need of a successful institution of plant industry in some way to collect information about work that is being done on the actual plants themselves.

The President—We have heard what Professor Harland has said and in the near future we may have such a connection. I feel sure that we can thank Dr. Neave very heartily for his paper, and what he has said will ensure for himself and his Bureau more support. It is a most important function which they perform, and we know that the Institution is alive to Imperialism. (Cheers.)

"THE IMPERIAL BUREAU OF MYCOLOGY."

BY

S. P. WILTSHIRE, M.A.

The Imperial Bureau of Mycology, which I have the honour to represent at this Conference, was founded a little over three years ago with a view to stimulating and co-ordinating plant disease work throughout the Empire.

The success which had attended the formation of the Imperial Bureau of Entomology was such that it was hoped a similar organisation to deal with the diseases of plants caused by parasitic fungi would prove equally valuable.

Much that Dr. Neave has said with regard to insect pests applies with equal force to diseases due to fungi and the organisation which the Bureau of Entomology has built up has indeed served as a model to us in developing our own Bureau.

Instances of the enormous destruction that can be caused by parasitic fungi are well known to all mycologists. The coffee disease in Ceylon, Panama disease of bananas, and white pine blister rust and chestnut blight in the United States are only a few of the long list of disastrous epidemics. In the colonies where new land is being brought into cultivation and where the crops grown have not become, so to speak acclimatized it seems that the balance of Nature is upset, and the liability to their serious outbreaks is increased. It would therefore appear that the study of mycology is going to become more and more important as the colonies develop and any organisation to help and unite mycologists in different parts of the world may be expected to prove of great value.

Briefly stated, there are two chief lines of work which the Bureau tries to carry out, namely, (a), the accumulation and dissemination of knowledge regarding diseases of plants, and (b) the identification of pathogenic fungi. In addition, there are other subsidiary objects which I will deal with later.

The need for some central body collecting and classifying mycological literature had long been felt by workers in the colonies and some means was required to put the colonial worker, often with very restricted library facilities, into closer touch with the progress of mycological research. The best method of doing this appeared to be in the first place, the publication of an abstracting journal, and for two years now the *Review of Applied Mycology* has been issued monthly by the Bureau to fulfil this purpose. We endeavour to keep the *Review* as up to-date as possible and though we do not claim to give a complete citation of all papers, we try to include all those of any real importance. We cover practically every language in which scientific literature appears with the exception of Japanese. Our abstractors scour the London libraries for the papers, some of which appear in very out of the way journals.

It is, however, much more satisfactory for us to have the original paper at hand for reference, and we hope, therefore, that in time we shall be able to obtain for ourselves most of the periodicals we abstract. From the nature of our work it is essential for us to have a good mycological library; at present most of our books are loaned to us by the Royal Botanical Gardens, London, and without this generous help it would be exceedingly difficult for us to carry on our work. We are, however, gradually accumulating a fair number of mycological works of our own and we are continually on the watch for books which would be of value to us.

Part of our library actually consists in the collection of authors' separates. We have at present about 5, 000 of these and they are specially useful to us in loaning to workers overseas. The hope that all mycologists will make a point of sending us duplicates, if possible triplicates of all papers they publish.

Another branch of our work lies in the building up of efficient card indices of all literature, past as well as present, so that we shall be able to give complete lists of references on any subject with the least possible delay.

In addition, we are also having prepared a host index giving all the fungi recorded on the various hosts. Dr. Butler saw the very complete host index they have at the Bureau of Plant Industry when he was in America, and by the kindness of the United States authorities we are having a portion of this index copied for our own use.

This briefly summarizes our work on the literary side. We are always anxious to help any one with the literature on the subjects they have under investigation and are prepared to hunt up original descriptions of fungi, to give transcriptions; to obtain books on behalf of workers or to help them in any way possible.

Then, coming to our second line of activity, the identification of injurious fungi, we regard this work equally as important as the first. The systematic study of fungi, however, has not reached as advanced a stage as that of insects, and specialists in the various groups particularly of the microfungi, to which most of the plant pathogens belong, are few in number and hard to seek. We are adopting the plan of referring difficult specimens to a recognised authority where this is possible. A very large amount of identification work, however, is done by the Bureau itself. We have accumulated a large systematic library and, of course, we have the immense advantage of having access to the Herbarium of the Royal Gardens, Kew.

We are gradually building up a Herbarium of our own, but this will be essentially a working Herbarium and we do not propose to keep type specimens.

In addition to this Herbarium, we are also accumulating a number of typical specimens of the more important diseases, to form ultimately the basis of a phytopathological museum.

Arising out of our work of identification, is the comparative study of pathogenic fungi, and it is hoped that the Bureau will be able to devote more of its energies to research on these lines in future.

We work in close touch with the Curator of the National Collection of Type Cultures of fungi at the Lister Institute. Any new cultures, especially authentic ones, we send to the Curator, who is always willing to supply us with any culture from his collection. We find this arrangement eminently satisfactory, and it obviates the necessity of our keeping a collection of cultures at the Bureau.

So much for the main lines of work of the Bureau. We do not propose to do any experimental work at Kew, holding that such work can only be done where the crops are growing.

Plant disease legislation is becoming more and more important as time goes on, and it is one of the minor activities of the Bureau to collect this information, and notices of new laws are regularly inserted in the Review.

Laboratory facilities are offered to any worker on leave in Britain at any time. We have a special room which we place at the disposal of visitors, and I am pleased to state that an increasing number are taking advantage of this facility.

Besides the diseases of plants, the medical aspect of mycology offers a wild field of research which has been little investigated. I attended a lecture by Dr. Cartekain to the British Mycological Society last year, and I was surprised to hear him say that about 30 per cent. of the human diseases in the tropics are caused by fungi. At present the medical workers are largely isolated from the rest of the Mycological world, and they have more or less adopted a nomenclature of their own. Dr. Butler has already taken some steps towards stimulating the study of these diseases and the Bureau may possibly be able to co-operate in this work, especially from the purely mycological side.

The study of veterinary diseases on similar lines is likewise needed, and one further branch of work in which the Bureau might help is the study of fungi of importance to technical manufactures and trades.

Another of our minor activities is to keep in touch with manufacturers of fungicides in order to be able to give any overseas workers up-to-date information of spraying materials now manufactured.

The manufacturers on their part, apply to us for information on recent work on fungicides, and works regarding the pests and diseases prevalent in the countries to which they are sending their goods. Finally, but not least, the Director of the Bureau acts as the mycological adviser to the Colonial Office, and matters are continually being referred to him from this source.

Before concluding I should like to say a little about the Imperial Mycological Conference which is to be held in July of this year. The Bureau was founded in 1920 and grants were given in the first instance for three years only. It was intended to hold this Conference last year to determine the future of the Bureau, but in view of the British Empire Exhibition in 1924 it was decided to defer it till then, and grants were continued on the same basis for one year longer. The probable date will be July 2nd or 3rd to the 5th, then uniting with the Imperial Botanical Conference from July 7th to 16th. The Conference will be a most important one for the Bureau, and I trust that most if not all our colonies will be represented. The first subject of discussion will be the future of the Bureau, mycology, the organisation, terms of sanction, and finances. Other subjects are (2), International legislation and quarantine against plant disease (probably this will be taken up in conjunction with the Ministry of Agriculture); (3) Plant disease surveys; (4), seed certification for health; (5), Investigation on fungicides; (6), co-operation and co-ordination of phytopathology work in the Empire; (7), Uniformity of scientific and popular nomenclature; (8), Publications.

At the Botanical Conference it is hoped to give three sessions (1½ days) to the Plant Pathology section, the subjects for discussion being (1), Obscure plant diseases of wide-spread occurrence.

(2) Relation of genetics to plant pathology.

(3) Relation of forest pathology to sylviculture.

There will also be a discussion on the cold storage of apples in the plant physiology section, and one on fungus attacks on wood and methods of timber preservation in the miscellaneous section.

If any Mycologist would like to add to the list of subjects for discussion I should be very much obliged if he would communicate with me.

In this brief summary, I have tried to give you some idea of the work the Bureau is doing. It is our object to develop on lines most useful to the mycologists in the various parts of the Empire and from the number of enquiries we receive and from opinions expressed we already feel we are fulfilling a real want in the sphere of applied mycology. (Applause.)

The President: Again I ask if any one wishes any further information on the paper which Mr. Wiltshire has read to us to-day. The importance of the Bureau is obvious and the paper shows how the work has been carried on. If any member of the Conference wishes to ask any questions about it, we shall be pleased to hear them.

Mr. Cousins: I feel that it is due from the point of view of Jamaica and our Government here and also, I hope, from the point of view of the Legislative Council in Jamaica, to state that we fully realize the great importance and value, not only of our gardens at Kew, but also of the three other Bureaux—the Bureaux of Entomology, Mycology and Veterinary Science—which tend to keep our Staff in Jamaica up to date. It is a pleasure for us to read their publications and to realize the brains of the men who write the papers and the personality of the men. I feel sure that the work which is being done by the Bureaux will convince public men in Jamaica and its Government, of the necessity of supporting these Institutions to our utmost and that we should do everything that is possible to enhance this valuable form of increasing the efficiency of the British Empire. (Cheers.)

Prof. Ashby: I would like to refer to the publication of this Review of Mycology. There was some doubt at first as to whether this review would be able to stand on its own legs, but I am glad to say that it has, and the review serves a very useful purpose of its own. It surpasses any of the other Journals which deal with the same subject and one of the points which strikes me is its up-to-dateness. We get information from it which is up-to-date and we are not served up with ancient history. They also give us other information to which many of us have no access. It has certainly given me very valuable information which I might not have been able to obtain elsewhere, therefore, I take it, if from only this point of view of the regular and efficient publication of this review, the Bureau is justifying itself. So far as the identification of fungi is concerned, it is also a very valuable help, but perhaps it has not yet been fully developed. The Bureau has a very unique opportunity of collecting samples of fungi and it is very desirable, that such work should be undertaken and the results published. That would be very encouraging to workers abroad. These are the two main aspects of the Bureau that I wanted to say something about. There is one other point. Mr. Wiltshire referred to fungi. Some people do not regard bacteria as fungi, while other people do regard it. There are certain other kinds of pests which are followed up now which are neither fungi nor bacteria, and the question arises to which Bureau we ought to send these samples.

Dr. Neave said although they did not really profess to be experts in that class of work, yet if it were sent to them they would do their best in the matter.

Professor Ballou, Professor of Zoology, Entomology and Assistant Commissioner of Agriculture of the Imperial Department of Agriculture said:—It might not be out of place for me to express my appreciation and the appreciation of other workers in the Tropics of the value of the work which is being done by these Bureaux. When I first came to the West Indies more than 20 years ago, I found that most of the insects were being sent to the British Museum for identification, but the British Museum was very much overworked, and it generally took some time before we could get from them the identification of the insects that were being sent there, and that was the difficulty which we encountered in the earlier days of our work in getting information; but more recently

we have been sending material for identification to the Bureau of Entomology and in most cases it is with surprising promptness we get their replies, because when one realizes that they had to deal with insects out here which they had not yet come across in connection with their work, it is surprising to get in the course of a couple of months the information from them telling us what these insects are and that they are to be found in the British Museum. We generally get their answers in eight or ten weeks. I will repeat a conversation I had with Dr. Howard the Director of the Bureau of Entomology at Washington. In that conversation I made reference to this publication that we have been speaking about to-day and Dr. Horneshook, the head of the Institute said: "I do not know what to say about it". I asked him what he meant and he said that the publication is so good that his own men would not read the original articles. They were quite content to read over the extracts from them. That was a striking illustration of the thoroughness in which these things are done, and I think it is a very great tribute and I have therefore added my own words to the testimony of the usefulness of this Institution. With regard to matters of research, I have no doubt that, as the needs arise and as the resources of the Bureau may make it possible, with the keen outlook and the energy required to keep the Bureau and its publications up to a high state of efficiency, other things will be taken in hand, and that all these will be things that bear on the needs of the Empire.

Mr. Wiltshire: I think we have to thank the gentlemen very much for the kind words which they have said about our Bureau. With regard to research, as a matter of fact very systematic work has already been done in this matter. (Cheers.)

The President: I think it is very important that it should have been brought to our notice at the beginning of our Conference, the large amount of work that is being done in a thoroughly organized manner in bringing difficult subjects to the very doors of our establishments in the Colonies. Information is now rendered available by these admirable Bureaux which are the outcome of the work that was begun at Kew. It was followed up by the Bureau of Entomology and now by the Bureau of Mycology. There is no doubt that as time goes on we will hear more of the work of these Bureaux. The point is that we now have behind us an immense amount of information readily available, as these three gentlemen, who read papers to us to-day, have so ably informed us—it means a greater strength of our work in the conflict which is to be fought with nature in dealing with Tropical Agriculture, and I think these gentlemen will be gratified to know how much their work is appreciated, and how much it is looked forward to, and how discouraging it would be if there was any suspicion that that work would not be continued and advanced. We have now concluded our morning sessions and we will meet again at 2 p.m. to-day with the intention of taking up the question of bananas.

The Conference resumed at 2.15 p.m., Sir Francis Watts presiding

The Chairman: Before we begin, I have one announcement to make I have been asked to inform visiting delegates that they have been made hon. members of the Liguanea Club during the period of their stay. If there are any visiting delegates not present, if those who are here will kindly pass that information on to them, I will be obliged. I will now ask Mr. Cousins if he will be so good as to present his paper. We have a long agenda before the Conference, and I hope Mr. Cousins will com-

press his information in as short a space of time as possible, and that the others who follow will do likewise.

"THE BANANA INDUSTRY IN JAMAICA"

BY

H. H. Cousins, Director of Agriculture.

Sir Francis Watts, ladies and gentlemen,—With regard to the compression of my remarks, I am in a very favourable position, because owing to the pressure of administrative duties I have to admit that the paper which I should contribute to the Conference has not been written. There, however are certain matters with reference to the banana industry of Jamaica which I think might be useful and of interest if brought forward to-day. After our last agricultural conference in Jamaica which was so tragically brought to an end by the earthquake in 1907, it has always been a moot point in agricultural circles as to whether the wisdom of the Barbados delegate, who was holding forth on the immense service of seedling canes to the sugar industry of that island, or whether it was the imminent incursion of the chemist in Jamaica on the topic of Jamaica rum that brought on the catastrophe. At any rate, bananas had nothing to do with it as the word banana did not appear on the agenda at all. To-day you have put the banana at the forefront. I take it that it is not only a compliment to the importance of the industry to Jamaica, but that there are other colonies in the West Indies which are seeking to see if they cannot have another string to their bow and would like to get some information from Jamaica which will help them to that end. In order that you might have a bird's eye view of the position of the banana industry in Jamaica in recent years—it has not a very ancient history—I have got here a record for the past 22 years of the number of stems of bananas that have been exported from Jamaica, the total value and the average price which the growers in Jamaica have received for their stems of bananas. In dealing with this matter, as some of the delegates are probably unfamiliar with bananas—I will apologise to the Jamaica planters present—I would like to explain that there is a trade difference in dealing with bananas between a stem and a bunch. A stem of bananas is simply what you might call a bunch cut off a tree, but a bunch as we know it commercially in Jamaica is anything from nine hands upwards—nine hands, ten hands, eleven hands, twelve hands, fifteen hands, or more, is a bunch for commercial purposes, and is paid for by the fruit companies as a bunch. So the effort of the Jamaica planters is to produce a standard bunch of nine hands. Anything below that is not a bunch; an eight hand bunch is known as a three-quarter bunch; a 7 hand as a half bunch, and a 6 hands as a quarter bunch. The figures here, on the extreme right of this paper, give the average price the planters of Jamaica have received during this time for their stems of bananas produced from the average banana land in the island. Intensive cultivation might yield greater results to the acre, and also certain rich patches where they have a very favourable rainfall. From the planters' point of view I am attaching equal importance to the administration through the Colonial Office. Some administrators have brought to Jamaica good luck and others have been Jonahs. We might not want to believe this but when we come down to solid facts and look over the figures of our trade we are obliged to admit that there is some element of truth in that suggestion.

Up to the year 1903 we had a most remarkable increase in the banana industry of the island. We had Sir Sydney Olivier with us at that time during a part of which he was our administrator. He remained with us up to the middle of 1903 and when he was going back to England he said he had tasted blood and he knew what the banana could do for Jamaica. Immediately after he went they sent along another Administrator who was unfortunate as before he arrived a hurricane came and he had to deal with it. The hurricane greatly reduced our banana output and during the whole of the time of the Administrator who followed Sir Sydney Olivier, we received much less than the old price for our bananas. And our revenue went down. Then the earthquake came. Sir Sydney Olivier returned and bananas again prospered. The output of bananas increased until we reached a record of over 16⅔ million bunches in the course of a year. After Sir Sydney Olivier left we had another Administrator. He proved a splendid Governor and an able Administrator but he was most unfortunate for we had a series of hurricanes during his administration which set back our bananas and greatly reduced our revenues. In the case of the present Governor we are all agreed that he has brought six solid years of prosperity for Jamaica. (Hear, hear.) For bananas, I will give the figures for 1923 for the accuracy of which I am indebted to my friend, the Hon. Acting Collector General, who knows a great deal about bananas besides being a very efficient Collector General. The figures for 1923 show that the number of stems we exported was 12,455,000 for which we got a little over £2,500,000, a very substantial sum indeed. It must be admitted that during 1923 it has been bananas that has kept the big man going and the small man going and has kept the Government machinery going. With regard to the industry itself I think it will be at once admitted by any one who has followed the progress of the banana industry in Jamaica that it is not an industry that we owe to Science or to Bureaux or to the Director of Agriculture. It had its beginning from a very modest source. It has been built up by the genius and courage, and industry and capacity of the people of this colony (hear, hear). The beginning of the industry in Jamaica was that a planter named Pouyat arrived in Jamaica a little over 80 years ago with one sucker of banana from Martinique, which we in Jamaica now call the Jamaica banana. From that one sucker has come the whole of the commercial banana industry of Jamaica and the whole of the industry in the West Indies and Central America. When we are talking about putting up statues to men who have done work for the island, I think there is one statue that we should put up in a most prominent place and that is to Mr. Pouyat who introduced the banana to Jamaica and saved this colony during the very strenuous and difficult times of the last thirty years (hear, hear). Another thing about the banana industry, sir, is that it is the most democratic agricultural industry to be found in the West Indies (hear, hear). There is the same price for the bunch for the big man and for the small man. We have no large factory giving as much as 12/-per ton for our canes when the just price should be 60/-, having regard to the price of sugar. In the case of the banana industry we have an absolutely democratic system and it is a fact that the small man in Jamaica is the largest producer in this trade and that it is principally due to him that the banana industry had been built up to what it is to-day. I am glad to hear of the efforts being made to establish the industry in the other islands. I want to say this to my colleague from Grenada, Mr. de la Mothe, whom I am pleased to see here to-day. I want himto take back a message to the people of his island—a message of encouragement to give the banana

a chance. Do not put all your eggs in one basket. Continue with your cotton and cacao but give bananas a chance. I know you have a splendid asset in possessing one of the strongest and most successful communities of planters I have met with in the West Indies and you also have a large number of small settlers who have proved their capacity by acting in great difficulties in a successful manner, and again I ask you to tell them to give bananas a chance. I would also urge this on my colleague from Trinidad. They have great possibilities for developing the banana trade there and have also the advantage of being outside the hurricane zone. However, I wish you, gentlemen, to remember that our experiences in Jamaica have shown that you cannot establish the banana industry on subsidized lines restricted to one small community, for if a hurricane came the whole of the profits would be swept away. In Jamaica in 1903, when the banana industry had reached great proportions, but cultivation was not as wide-spread as at present, the whole of the profits of the year were swept away in one breath. We must have co-operation to insure the prosperity of the industry. If we get co-operation between the British West Indies—I hope we will have this in the near future—there is no reason why we should not produce the whole of the bananas required for the Mother Country, Canada, and other British countries. If we could get the relationship of the islands contributing to the banana trade closer, that trade would be immensely increased to the benefit of us all. It would also be better protected against disasters. Even in Jamaica the fact that we grow bananas from the extreme eastern end to the exterme western end is a security against complete destruction by hurricane, a guarantee that the whole of the industry will not be wiped out at any one time, as it is seldom the whole island is hit by a hurricane. I hope that one of the successes of the Conference will be a very enjoyable tour which I believe is being arranged for those interested in bananas to learn of our banana industry at first hand and the great extent to which bananas are grown in all parts of Jamaica. I have no doubt that the banana in Jamaica has done more for the progress and civilizing and upgrading of the people of Jamaica than any other thing that has been tried here. (Applause.) There is a cloud hanging over the industry at the present time, and Sir Francis Watts and the Imperial College of Agriculture are fully equipped to assist us in warding off the trouble. I allude to the banana disease. We in Jamaica are in a peculiar position with regard to that disease because it is proved that we have had it here officially in Jamaica for twelve years, and unofficially for at least twenty years. At the present moment our statistics show a somewhat serious rate of the extension of the disease. In the past year it was 2,000 plants in 60,000 acres. At the present time it is a bit more serious: 13 acres of land in 60,000 acres but, gentlemen, we have to remember this, that wherever the banana disease appears that is dead land for Jamaica for our bananas. No Jamaica bananas will ever grow there again. So that, unless we can extend our area of cultivation, and we have not an unlimited supply of land, or we can check the spread of disease, the future will be serious for the banana industry. We have been combating it with every possible means at our command, and, as I have said, our position here is different from that in other banana producing countries in this part of the world; statistics prove this. The reason why we are getting 3/6 per bunch for our banana in 1924 is simply and solely due to the fact that the Fusarium which causes the banana disease is far less virulent in Jamaica than in South and Central America. Its extreme virulence in South and Central American

countries, I must say, is a blessing to our banana industry. I take it that the fact that the banana disease spreads so slowly in Jamaica, is due to our being a little more to the north than these countries. Its virulence is somewhat less, and we can carry on while the other countries are going out, and so we are able to compete with them in spite of the advantage that they have over us for the production of fruit. It seems an awful and heartless thing to say, but it is the truth, and this is seen when one looks at it squarely in the face. We are well aware that after our hurricane in 1903 the industry in Central America was built up, and if we did not have this disease we could not compete against them with their thousands upon thousands of acres of fertile lands producing our Jamaica bananas at 3d. and 4d. per bunch, and the bunches being much larger than we can grow here. We would have been put completely and entirely out of business, and our present position to-day is entirely due to the attack of this Fusarium, which has restricted cultivation in these countries to a considerable extent, and has enabled Jamaica to remain in the business. We in Jamaica are very anxious to find a banana resisting the disease, and we are at the same time anxious that they will not find one in Central America (hear, hear). If they can get something that will grow there resisting the disease and producing 12 hand bunches at a cost of 4d. a bunch, then we will have to get out of the business. We are very anxious indeed that we should get ahead of Central America in the matter. I hope that any discoveries made by our department will be safeguarded, and that any discoveries which the Imperial Department of Agriculture may make in respect to bananas will be kept for the benefit of British industry. I may mention that we are experimenting in Jamaica now with a banana which has proved resistant to the Panama Disease, and I will state briefly the circumstances under which it was introduced into this colony. Fourteen years ago, a small Jamaica settler was living in Guatemala and he found a very fine banana different from the other varieties, producing splendid bunches of good fruit. In fact, he considered it the best banana he had come across. When returning to his native land, to settle down, he packed one of the suckers of this banana in his grip, and got it through the customs wrapped up in an old shirt although it was against regulations to bring in any such plants. As it has turned out, that evasion of the regulations is likely to be a most fortunate thing for the Jamaica banana industry. The settler took the sucker to his home in Manchester where he planted it, and from that one sucker to-day we have over 2,000 plants of the banana, which we have planted in the actual holes where diseased Jamaica bananas have grown. And they have grown up in those infected holes and they have produced splendid bunches of fruit, which have been taken readily by the fruit companies and put on the markets abroad. I do not know the name of the gentleman who brought in this banana plant, but we have christened it "Robusta." Experts who have seen it recently, tell me that it is really a banana from Grenada, where they call it the "Giant Fig." It is a very fine banana and very useful indeed in Jamaica for the small settler, as it will give nine hand bunches where the ordinary Jamaica banana will only give a seven hand. It is immune from disease and is easily shipped. There is only one thing against it and that is it is rather lacking in backbone. If the Imperial College of Tropical Agriculture can develop a disease resisting banana that is superior to our Jamaica banana in strength of spine and capacity for standing hard treatment on its route to market, and is moreover a fruit to be appreciated by our customers abroad, and further

will take care that the beneficiaries of this valuable production shall be Jamaica and the Imperial Possessions of the West Indies, posterity will indeed bless the establishment of this Institution. (Applause.)

Banana Trade of Jamaica, Year 1920-1923, *inc.*

Years.		No. of Stems.	Total Value.	Average price per stem in Shillings.
1902		11,003,840	825,288	1.5
1903		14,184,375	1,134,750	1.6
1904	Hurricane August 1903	7,803,243	585,243	1.5
1905	..	8,903,739	514,191	1.2
1906	..	14,981,145	842,689	1.1
1907	..	16,009,662	880,531	1.1
1908	..	13,942,567	1,038,721	1.5
1909	..	14,612,881	1,044,821	1.4
1910	..	14,095,191	1,141,710	1.6
1911	..	16,497,385	1,456,582	1.8
1912	..	13,382,072	1,241,187	1.9
1913	Hurricane November 1912	11,597,888	988,236	1.7
1914	..	16,201,772	1,490,563	1.8
1915	Hurricane August	8,156,860	599,529	1.5
1916	Hurricane August	3,499,565	222,497	1.3
1917	Hurricane September	2,394,514	227,479	1.3
1918	No competition in Trade	3,201,465	297,736	1.9
1919	Competition in Trade (September)	9,673,557	936,014	1.9
1920	..	9,037,028	1,333,865	2.9
1921	..	9,959,144	1,265,811	2.5
1922	..	12,713,849	1,699,366	2.7
1923	..	12,455,310	2,265,309	3.6
		244,307,052	22,032,118	..
	Average for 22 years	11,104,866	1,001,460	1.6

Sir Francis Watts: Mr. Cousins has given us a broad account of the banana industry in Jamaica, and has also placed in our hands some very striking figures with reference to it. Before we proceed to any discussion of the matter Mr. Cousins has laid before us, I think it will be convenient if we hear the remarks of Mr. Nowell with regard to Trinidad and the banana industry.

Mr. W. Nowell (Trinidad): Mr. President, ladies and gentlemen: Mr. Cousins has had the somewhat difficult duty of reading a paper that was not yet written. I have the still more difficult one of speaking on an industry that does not exist. I notice I am down on the programme to give an account of the Trinidad banana industry; in the sense in which you have a banana industry in Jamaica, there is no such thing there.

Just before the war experiments were proceeding in Trinidad with a view to the shipment of bananas that were to be carried away, and in some way distributed in England by the Royal Mail Service. Very largely the first banana to be planted in Trinidad at the Government Farm was the Jamaica banana, but in 1919, they had to be eliminated on account of the extent to which they had been attacked by the banana disease, and we must turn to the Canary banana or seek for the strong new variety that has been hinted at by Mr. Cousins. The Canary banana has considerable defects as a commercial article. Those of us who have seen in England how the Canary banana is landed—boxed up in wooden crates, wrapped in cotton wool and tied round with tissue paper, and seen the way bananas were being landed from Port Limon, realise that the Canary banana will never be more than a fancy trade; but that for the general trade, we will have to look to the Gros Michel or some other variety. Our difficulty in developing he industry is this: although we have no banana industry in Trinidad, bananas are grown all over the country. Trinidad is predominately a cocoa country, but a lot of bananas are planted on the same farm with cocoa. The result is that although we have no banana cultivation, banana disease has become unfortunately pretty generally distributed throughout the country. The position at present is that no one will risk his money to plant the Gros Michel commercially on account of the probability that within a very few years, they would find that the plants were all diseased So that we are now in the position Mr. Cousins has sketched for Jamaica, and our interests in that respect is the same as yours; and if we are to re-start bananas we can use your experience. If we are to go in for bananas, our planters will have to turn their activities from cocoa now growing on banana lands. However, that difficulty will be met, and will, no doubt, work itself out eventually. I hope that the interests of Jamaica and Trinidad will not be found to clash but will be harmonious, the one to the other. If there are any questions that anyone would like to ask with regard to the position in Trinidad I will be glad to answer them, otherwise I can add nothing to what I have already said. (Applause.)

Sir Francis Watts: I do not know if anyone wishes to raise any point or ask any questions at this stage. We shall be dealing with bananas all the afternoon and we can come back and ask questions later on if desirable. If there is no pressing point, in order that we go on with our bananas, I would like to ask Mr. Hansford to tell us about his researches with regard to the Panama Disease in Jamaica. But perhaps before Mr. Hansford reads his paper, I may read a few notes I have put together myself with regard to the actual nature of the disease. [Sir F. Watts read some notes on Panama Disease at this point. Ed.]

Mr. C. G. Hansford read his paper on Panama Disease in Jamaica as follows:

"SOME REMARKS ON QUESTIONS RAISED BY THE PANAMA DISEASE OF BANANAS."

BY

C. G. Hansford, M. A. (Cantab.)

The history of this dreaded disease of bananas is familiar to most people here . Its effects on the banana growing industry of such places as the Limon district of Costa Rica, Panama, Surinam, Honduras and

other parts of Central America are often quoted as classical examples of the devastating effects of Plant Diseases. The first association of a *Fusarium* with a vascular disease of the banana was due to the work of E. F. Smith who isolated an organism, named by him *Fusarium cubense*, from diseased banana material sent him from Cuba. He was unable to describe the symptoms of the disease in the field, as he had not seen it. Essed and Drost, working in Suriname in 1910-12, carried out [illegible] work on the disease, but their cultures of the causative organism were contaminated, as they described ascomycetous stages in the life history of the fungus. Prof. Ashby, working in Jamaica, published in 1912 a very detailed account of the disease as manifest in the field, and also the first account of the morphology and cultural characteristics of the causal *Fusarium*.

The measures used by the Director of Agriculture, Mr. Cousins, for the control of the disease, were continued by Prof. Ashby, and have been in constant use in Jamaica ever since. The next detailed account of the disease and the *Fusarium* causing it was published by Brandes in 1919, and since then very little has been added to our knowledge. He incorrectly associated the disease with Smith's *Fusarium cubense*, and gave a detailed diagnosis of the organism. Gaumann, working in Java, in 1921 published a long and detailed account of a vascular disease of the banana and its relatives which he says is very prevalent there. He concludes that this disease is caused by a bacterium although he found several species of Fusarium in the discoloured vascular bundles of affected plants. He was unable to isolate a single species of Fusarium as constant in occurence as *Fusarium cubense* in the case of the true Panama Disease. In view of this and other statements he makes about the Java disease it is probable that he was dealing with a distinct vascular disease. He is of the opinion that *Fusarium cubense* has not been conclusively proved to be the cause of Panama Disease, but in view of the consistent results of inoculations carried out by various workers on the Panama Disease of the West Indies, this opinion seems to be discounted.

ECOLOGY OF THE DISEASE AND FIELD OBSERVATIONS.

It has always been noticed that the rate of progress of the disease is influenced greatly by climatic conditions. On the one hand we have regions of heavy, almost continuous, rainfall, such as Suriname, where the disease proved extremely virulent and aggressive killing out the entire banana cultivations in the course of about four years. Also in the coastal plains of Costa Rica the lands are frequently flooded by the large rivers and the bananas there succumbed wholesale to the disease. On the other hand, where bananas are grown in dry regions under irrigation, as in Santa Marta, southern Porto Rico, and the plains of St. Catherine in Jamaica, no case of the disease has ever been found, as far as the writer is aware. However if bananas growing under these conditions are inoculated with the fungus causing the disease, they will invariably show symptoms of it sooner or later, showing that the climatic conditions are not such that the disease is incapable of affecting the plants. Under natural conditions, however, it is evident from actual experience that the disease is not to be feared in these irrigated regions. As a case falling between these two extremes of climate, we may quote that of the other parts of Jamaica, where the rainfall has been somewhat lower than the average during the last few years. Although the disease has been present in the island for about twelve years, its influence on the actual production of bananas has been very limited as shown by the annual export figures.

It has been asserted repeatedly that the fungus causing Panama Disease is present in virgin soils, that is in soils which have never before been planted in bananas. This assertion is based chiefly on field observations and experience, especially in Central America, where the large fruit companies again and again cleared forest lands and planted them in bananas, only to find that a considerable proportion of the first crop was lost on account of the disease. In Jamaica the situations of some of the outbreaks of the disease lend colour to this suggestion that the fungus is to be found in so called "healthy" banana land, and attacks the banana under some unknown combination of soil and weather conditions. Having once attacked the banana it is assumed to be capable of spreading from plant to plant in the immediate vicinity of the originally diseased plant. Certain earlier investigators analysed a large number of these "healthy" banana soils, and found that they contained a fungus which they were unable to distinguish from *Fusarium cubense*. The tests used by these workers have recently been subjected to severe examination here in Jamaica, with the result that they have been found to be totally inadequate, and therefore the mass of results on this point accumulated by these workers must be discarded as valueless. Also, in several instances here in Jamaica, the subsequent history of the plots of land which were thus pronounced to be diseased by these workers, has not substantiated their predictions. Recently it has been determined by a large series of laboratory cultures and inoculation experiments that the only test for *Fusarium cubense* is that of inoculation into healthy banana plants, and that in the laboratory it is quite impossible to distinguish it from other very closely related species of *Fusarium*, which are purely saprophytic in habit, or at least, are not able to attack the banana plant. The only situations from which cultures were isolated which were capable of causing typical disease symptoms in inoculated plants, were plants actually suffering from the disease, and the soil in their immediate vicinity.

Viewing the field observations and experience referred to above, in the light of these laboratory results, there is a great discrepancy apparent. Although the field experience seems to point to the view that the organism causing the disease is present in so-called "healthy" banana soils there is no actual laboratory evidence to support this conclusion. Indeed, the laboratory results seem to point to the opposite view, namely, that the fungus causing the disease is restricted in distribution to affected banana plants and to the soil immediately around them. The field experience must be explained by the introduction of the disease on the suckers used for planting these new areas, either internally, or externally in particles of soil adhering to them.

In connection with the experimental work on the diagnosis of *Fusarium cubense* referred to above, a large series of Fusaria of the section *Elegans* to which the organism responsible for the disease belongs has been isolated and studied. This study has led to the conclusion that the present classification of the section is useless and that our present conception of a species of Fusarium must be revised and broadened. At the moment there is a considerable number of species referred to this section of the genus, but, although very detailed diagnoses are given to most of them, it is impossible for us to refer a new strain of Fusarium to any of these species already described, as the diagnoses given are so similar, and overlap to so great an extent. The result has been that in recent years workers on this group have described their cultures as new species of *Fusarium* in order to save themselves the trouble of attempt-

ing to identify them with species previously described by other workers, and have thereby added considerably to the present confusion surrounding the group. Also, many of the species of this group are vascular parasites, causing wilt diseases of a large number of different plants. Though complete series of cross-inoculation have never been carried out, it is very probable that the various species are not cross-inoculable from one host to another, and that each has a definite host range. This has resulted in each being described as a distinct species of Fusarium. During the course of a detailed study of the cultural characters of a large series of Fusaria belonging to the section Elegans, it has been noticed that the differences between individual strains are very small and the cultural characters of each strain have proved to be very variable, though grown under apparently identical conditions. This variability has been noticed in the size of the macroconidia, the presence of sporodochia, the colour of mycelium, substratum, and sporodochia, and the presence and colour of sclerotia. All these characters are utilised in the most recent classification of the group by Wollenweber, who assumes them to be more or less constant. As in the above study they have all proved to be so variable they must now be considered of little value for classificatory purposes.

The result is that we are left with a great number of more or less different strains of Fusarium, and without any definite criteria on which to base our classification, and to collect them into distinct species. In our opinion it is preferable to regard them all as distinct strains of one and the same species, and thus to put an end to the hopeless confusion in which the present classification of the group has resulted.

To quote an example:

A number of strains of Fusarium from different sources have been isolated, which have proved to be culturally and morphologically identical with *Fusarium cubense*. On inoculation into healthy banana plants a great difference was observed between them and the true *Fusarium cubense*, isolated from diseased banana material. The latter in every case gave typical symptoms of the disease in the inoculated plants while the other cultures have never given any sign of infection of a banana plant. This results in the fact that the only possible diagnosis of *Fusarium cubense*, is as the species of *Fusarium* responsible for the wilt disease of *Musa sapientum* and other closely related species of *Musa*, as this is the only character on which it can be separated from other saprophytic Fusaria closely related to it. From our general field experience of the disease here in Jamaica we have concluded that it is spread in the following ways:

1. By the planting of suckers in incipient stages of the disease.

This method of spread of the disease is responsible for outbreaks on many holdings and estates in Jamaica, whose owners have planted suckers regardless of whether or not they came from fields or districts badly infected with the disease. All suckers for planting should be examined as they are cut from the parent plant for any sign of disease in the rhizomes, and none should be planted which have been taken from a field badly infected with the disease, as the risk of bringing away infection on the outside of such suckers in particles of soil adhering to their surface is far too serious to run. While it is impossible to make absolutely sure that the disease is not being introduced into healthy fields by the suckers used for planting, much can be done towards this end by observing these simple precautions.

2. The second method by which the disease is being spread largely in Jamaica, is by Banana Trash.

There is abundant evidence that the indiscriminate use of banana trash for mulching bananas, regardless of its origin, has in the past been responsible for much of the spread of the disease from one district to another. Recently, a series of Orders has been issued in Jamaica to control the use of banana trash for packing purposes. Trash may be used as mulch only provided that it has not come into contact with the ground outside the cultivation where it was grown, nor with other banana trash from different properties. This eliminates as far as is possible the risk of banana cultivators picking up trash from around the buying stations for fruit and carting it to their plantations for use as mulch and manure. All such banana trash at the buying stations must be regarded as liable to be infected with the disease, and burnt at the first opportunity.

3. By wind-borne spores.

This third method of spread of the disease cannot be directly controlled. Our only measures of protection against this method of spread of the disease is to prevent as far as is possible the formation of the spores of the fungus on the diseased banana plants. This formation of spores on the actual diseased plant takes place at a relatively late stage of the disease, and can therefore be prevented to a considerable extent by treatment and destruction of such plants as soon as found. The disease can be recognised at a stage before spore formation of the fungus on the surface of the plant has commenced, and should be treated at this early stage. As far as is known, the fungus forms its spores in the field only on the surface of certain parts of the diseased plants, but it is probable that it is also able to form them in large quantities on the surface of damp banana trash lying in the cultivations. Certainly, as indicated above, it has been demonstrated that banana trash from infected districts has been largely responsible for the spread of the disease from district to district, and in the laboratory the fungus grows profusely on sterilised banana material forming large numbers of microconidia on its surface. Also when grown on sterile soil in the laboratory the fungus has been found to produce large numbers of conidia, so that there is the possibility that the fungus forms spores on the surface of the soil in diseased areas in the field, in moist weather. As the spores are able to infect healthy banana plants only through the soil, it is evident that no measures of protection of the plant by spraying with chemicals will be of any use.

4. The fourth method of spread of the disease is by the transportation of diseased soil from place to place.

Cases have occurred in Jamaica where the presence of the disease in a small holding has been traced to the owner having taken suckers of cocoes (tania) and other similar ground provisions from quarantined areas, to plant among the bananas in his cultivation. By doing this he has also carried the fungus of Panama Disease in particles of soil adhering to such roots and suckers among his own bananas, which have afterwards succumbed to the disease.

Control of the Disease.

In dealing with most plant diseases it is possible to attack the problem of controlling them from two entirely distinct standpoints. One of the methods open is to devise measures to control the disease as far as is possible on the crop actually susceptible to its attacks. The other method of attacking the problem is to replace the crop susceptible to attack by another which is either more resistant or immune to the disease. Up to the

present this second method of attacking the problem of Panama Disease has not yielded good results, though much is hoped from it in the near future. Our efforts in Jamaica until quite recently were entirely devoted towards stamping out the disease on the Gros Michel, or at least to reduce the extent of its attacks. With this object in view, certain measures were adopted which will be referred to again below. Although there is little room for doubt that these measures have had considerable effect on the disease, we have to admit that they have not proved entirely adequate. It is certain that if they had not been adopted that the disease would be far worse to-day in Jamaica than it actually is. The result of the measures adopted against the disease has been that we have to-day an ever increasing number of small or extensive plots of land scattered throughout the large banana districts of the island. Most of these plots are the property of small holders who are very hard hit by the disease. In consequence of this, efforts have recently been made by the Department to attack the question of control of the disease from the second point of view, namely, that of substituting a crop which shall be either immune or very resistant to the disease, for the ordinary Gros Michel banana of commerce. Owing to the peculiar market and commercial conditions of the agriculture of the West Indies at the moment, the only crop which would appeal to planters is the banana. Consequently, the Department of Agriculture, as well as the other large interests in the West Indies, has of late been searching for a variety of banana which shall be immune to Panama Disease, and at the same time satisfy the requirements of the shippers and consumers.

These requirements are so very exact and inelastic that, of the many varieties experimented with by the United Fruit Company in Costa Rica some years ago, none proved satisfactory, and all were ultimately discarded as worthless from the commercial point of view. Lately, however, an immune variety has been found growing in several districts of Jamaica, and the Department has commenced a nursery of this variety, in order to test out its suitability from a commercial standpoint, as a substitute for the Gros Michel. It is obvious to anyone acquainted with the Panama Disease, and the commercial side of the banana industry, that if a suitable substitute for the Gros Michel were discovered at any time, the whole problem of the disease would be solved immediately. The variety now being tried out by the Department of Agriculture here in Jamaica has been identified as the "Giant Fig" of Grenada, and the "Boumelan" of Surinam. Under these different names it is being developed in the countries named with a view to putting it on the market as the desired substitute for the Gros Michel.

Another method of obtaining resistant varieties of bananas has recently been brought to the fore, especially by the staff of the Imperial Agricultural College in Trinidad. This is the crossing of the susceptible variety Gros Michel with other resistant varieties, such as the Cavendish, with a view to obtaining a variety which shall combine the good characters of both parents. During the course of this discussion on Panama Disease, we shall doubtless be informed of the progress made along these lines.

The Present Position with regard to Panama Disease in Jamaica.

The disease, as is common knowledge, was discovered here in Jamaica in 1912, in two distinct centres of the island, one in the hills behind Duff Bay, and the other at Claremont, in St. Ann. Shortly afterwards, other cases were found at Canewood, a seaside estate in Portland, and also in

the Riverside—Williamsfield district in the extreme west end of the island. The distances between these centres are considerable, and it would appear that each was a separate and distinct outbreak. Since this discovery of the original outbreaks of the disease in 1912, others have been found in other parts of the island, having no apparent connection with previous centres of the disease. Such are the outbreaks discovered in St. Mary in 1918, in St. Thomas in 1920, those in the parishes of St. James, Manchester and Clarendon in 1922, and that in the John Crow Mts. behind Manchioneal in January, 1923. In several of these cases there is overwhelming evidence that the disease was introduced on banana suckers brought from Central America by labourers returning to Jamaica. For instance, the first outbreak of disease at Broadgate, St. Mary, occurred in the cultivation of a labourer who had planted there a variety of banana new to Jamaica, which has also since proved immune to the disease. Exactly the same was the case in the district of Solio in St. Thomas, where the same variety has been discovered; and also this immune variety has recently been found in the originally infected areas around Riverside, in Hanover. It is thus evident that, though this variety of banana has proved immune to the disease under Jamaican conditions, it is still capable of carrying the infection from one district to another, presumably in particles of soil adhering to the surface of the suckers.

From these districts of what might be termed "Primary Infection" the disease has spread gradually year by year. In the parish of Portland, under fairly moist conditions and where large areas of land are given over to the cultivation of bananas, the disease has spread most rapidly. However, even in this parish the disease has, up to the present, made but little difference to the actual production of bananas, as the areas lost to cultivation by reason of infection with the disease, have been compensated for by the extension of the banana growing area into new lands, and by the growing of bananas on lands formerly given over to other crops. This process, if long continued, will naturally in course of time exhaust the reserves of banana lands in this parish and then the influence of the disease upon the actual production will be more marked.

It will be gathered from the few preceding remarks that the disease is following along the same lines in Jamaica as it did in the large banana areas of Central America; that is, it is gradually driving the banana cultivation further and further inland into the hills. In Jamaica, however, up to the present this process has been very slow as compared with what occurred in the lowlands of Central America. This is probably due in some measure to differences in climatic conditions and, therefore, also in soil conditions, between the two countries; Jamaica in recent years also showing a much smaller rainfall than Central America. Also, the flooding of large tracts of land does not occur in Jamaica as it does in Costa Rica, whereby portions of diseased bananas and large quantities of diseased soil are distributed over the whole area of cultivation. In Jamaica, ever since the original discovery of the disease, every effort has been made to retard the spread from district to district by means of strict quarantine measures. During the earlier years, and to a certain extent at the moment, these efforts have been partially neutralised by the total lack of co-operation between planters themselves and the officials of the Department. This has been the case especially with the smaller banana growers, who have made no effort with regard to the planting of disease suckers, and who have even been known to steal the adventitious suckers from a diseased area to plant in their small banana walks.

The only possible result of this attitude was the wholesale spread of the disease among the small settlers. This has actually taken place, and most of the cases of disease treated up to the present time have occurred among these small banana growers. This spread of the disease among the small banana growers now constitutes a grave danger to the large banana farms, which are now becoming infected in spite of all the precautions taken.

The negligence referred to above has not by any means been confined to the small settlers. Cases are known where large planters have not only neglected to take precautionary measures with regard to the suckers they have planted in their fields, but have actually hidden the presence of the disease on their farms from the knowledge of the Department, with the result that it has been allowed to reach serious proportions before any effort was made to check it.

It is obvious that any system of quarantine against a disease of the nature of Panama Disease, to be effective at all, must be supported by the co-operation of all parties concerned. At the present moment, in the parish of Portland, many of the small settlers have suffered severely from the disease and now realise the need for reporting cases as soon as they are noticed in their cultivations. Much has been done by means of lectures, to teach them to be very careful, when planting suckers, to see that they are free from any internal signs of the disease, as shown on the surface where they were cut from the parent plants. They have been advised repeatedly to buy suckers for planting only from cultivators whom they know to have had no disease on their cultivation. Whether or not they act on the advice given them is another question.

The methods used at present by the Department in dealing with this disease are essentially the same as those originally used in 1912 and are briefly summarised as:

(1) The treatment of cases of the disease as soon as they are discovered.

(2) The quarantining of infected land.

(3) Advice to banana growers with regard to measures designed to assist them to exclude the disease from their plantations.

The treatment of actual cases of disease consists essentially of the total destruction of all diseased material by fire, wherever possible, and the destruction of all adjacent healthy banana plants within a chain of the diseased plant. Where it is impossible to destroy the diseased material by fire, it is chopped up into small pieces and covered with quicklime, with the object of causing its complete disintegration as early as possible. The object of this destruction of diseased material is to prevent as far as is possible the dissemination of the fungus by means of its spores through the air.

As the fungus has been proved repeatedly to exist in a virulent state in the soil around the site of a diseased plant for a number of years, it is evident that if bananas be planted on such an area they will soon succumb to the disease. Also, the disease is capable of spreading from plant to plant through the soil. To prevent this, an area around the site of the diseased plant is cleared for a distance of a chain away from it, and fenced off and quarantined. That this area is sufficient for the purpose is proved by the very few cases which have occurred where a plant next to such a fence has afterwards succumbed to the disease.

The net result of these measures is that for each case of Panama disease an area of a square chain is isolated and quarantined, no bananas being allowed in this area again. It has been our experience that it is not advisable to permit any cultivation of ground provisions, such as yams, cocoes, etc., in these areas, as these are liable to be taken away

and planted elsewhere in small settlers' cultivations, with the inevitable result that the bananas in them sooner or later contract Panama Disease.

Planters are advised by the Department to exercise certain measures designed to exclude the disease from healthy cultivations as far as it is possible to do so. Such measures as the following are advised:

Inspection of all suckers before planting.

The procuring of suckers from only those fields which show no disease up to the present.

The careful supervision of labourers who bring their own tools to work on the plantation and the disinfection of such tools before use.

A constant lookout for any signs of disease in the neighbourhood and the reporting of such to the Department.

Our experience here in Jamaica points to the following methods of spread of the disease:

1. By the planting of diseased suckers, or suckers from infected areas; a method easily controlled by observing the advice given by the Department.

2. By banana trash. This is used for packing all kinds of produce all over the island, and under the present Orders, it must be burnt when finished with, and not used as mulch on plantations. The present Orders have been framed to prevent the indiscriminate use of banana trash for mulching purposes, regardless of its possible origin from cultivations infected with Panama Disease.

3. By spores through the air. This method of spread of the disease cannot be directly controlled in any way.

Such is a brief outline of our present position with regard to Panama Disease here in Jamaica. I have dealt with the parish of Portland, as more than half the number of cases of disease treated in Jamaica have occurred in that parish, and the position in the other parishes is not nearly as serious at the moment. The results obtained by adopting the measures outlined above are shown in the following figures of the number of diseased plants treated during each year since its discovery here:

1912—625.
1913—164.
1914—128
1915—165.
1916—231.
1917—154.
1918—208; increase of 33 per cent.
1919—279; increase of 33 per cent.
1920—456; increase of 60 per cent.
1921—1,247; increase of 175 per cent
1922—3,804; increase of 200 per cent.
1923—4,007; increase of 6 per cent.

There is no room for doubt that had these measures not been adopted at the outset the figures just given would have been different.

Reviewing our present position in Jamaica, we may briefly summarise it as follows:

Up to the present we have been attempting to control the disease, or, at least, to check its spread as far as possible, by a method which may be described as amputating the fingers one by one to save the rest of the body. This process has resulted in our accumulating a considerable number of small areas, which are now in quarantine. One question now being brought very much to the fore is the utilisation of these patches, which belong in most cases to small settlers, in such a way as not to imperil any nearby banana cultivations.

A second point has recently arisen in connection with this method of dealing with the disease. Where a district has become more or less generally infected and cases occur very frequently, our methods of treatment may kill out the bananas in such a district much faster than would the disease if left to itself without having any appreciable effect on the frequency with which other new cases occur. This point is likely to be raised more frequently in the future, and we must determine whether or not, under such circumstances it would be preferable to quarantine smaller areas than those used in districts not so severely affected.

On comparison of our present position here in Jamaica with that in Central America, certain fundamental differences are manifest. In Jamaica we have no extensive tracts of good banana land rendered useless for cultivation on account of infection with the disease, which are at all comparable with the flood areas of Costa Rica. Our problem here at the moment is how to protect our present "healthy" banana cultivations and districts from the inroads and ravages of the disease more efficiently than we have been doing up to the present. The more efficient this protection system can be made, the longer can we postpone our answer to the second and greater question raised by the disease—that of the utilisation of the diseased lands for banana cultivation.

These are the great problems raised by this disease, which must sooner or later be solved by the banana growing industry, in one way or another. The first, namely, that of the efficient protection of healthy cultivations of the Gros Michel especially concerns us here in Jamaica at the moment. The second, that of the utilisation of the diseased lands for the cultivation of bananas once more, is of vast importance to such countries as Costa Rica, Surinam, Panama, Honduras, etc. It is also coming gradually to the fore in Jamaica, as the extent of such areas increases from year to year.

I have mentioned above that a number of varieties of banana known to be very resistant or even immune to the disease, and it is evident that if any of these were found to satisfy the requirements of the market, that the whole problem of Panama Disease would be solved immediately. The work now being started along these lines, that is, of producing a variety both resistant to the disease and suitable for the market, is likely ultimately to prove the salvation of the banana industry of Central America. At best the measures hitherto adopted for controlling the disease on the Gros Michel have but postponed the day when it will not be profitable to cultivate this variety on account of the disease.

Sir Francis Watts: Mr. Hansford has given us an excellent account of the banana disease and its incidence in, and effects on, Jamaica and parts of the neighbouring countries. Before we go further into the matter, I think we may now hear what Prof. Ashby has to say with regard to the researches made in this direction to see if we can bring a sort of focus on the matter.

Mr. Stedman: May I ask, before we ask Prof. Ashby to speak, how many inspectors were employed four years ago, and how many are employed now. It makes a big difference with regard to the number of cases now reported. There is a very strict supervision now right throughout the country and if we had it a few years ago, I think it might have made a big difference in the number of cases. We have now inspectors in every parish.

Mr. Cousins: We have now ten inspectors. Previously we had four.

Mr. Stedman: That will make a big difference in the number of cases reported. It is not that there is such a big increase, but more cases are now being reported owing to inspection.

Hon. E. A. Harrison: The inference to be drawn from Mr. Stedman's question would seem to be that by increasing the number of inspectors we have increased the disease (laughter.)

Mr. Cousins: I may point out that in spite of the increased number of inspectors, the increase last year was not 6 per cent., and that in the last half of the year, we really had a reduction of 20 per cent. I feel sure that if we had a few more inspectors we might effect a positive reduction.

"RESEARCHES ON PANAMA DISEASE."

BY

PROF. S. F. ASHBY, B.SC.

Mr. President, ladies and gentlemen: I am going to say something to you with regard to the research work started by the Imperial College of Agriculture with reference to the attempt to create a banana which might prove to be highly resisting to banana disease. Of course, when Mr. Cousins and Mr. Hansford used the word immune, they used it in a relative sense, because absolute immunity does not exist. So in speaking about bananas and the term "immune," it would perhaps be better to use the expression "highly resistant," or very highly resistant— that would be a much better term, I think, to use in regard to a particular plant with respect to a particular disease, because as we know there is no such thing as absolute immunity. We have relative immunity. An attempt has been started at the College, to either discover a banana already existing or create one by hybridization which might turn out highly resistant to disease under local conditions. I will read a paper which I have not prepared myself; it was prepared by Prof. Dash of the Imperial College of Tropical Agriculture and gives a sketch of the work which has been done in connection with the pollination, with a view of getting seed and raising banana plants from seed, and then testing them out subsequently to see how they fare in regard to disease. Prof. Dash has put down those results in his paper.

Testing resistance of varieties is a necessary part of the work which is being undertaken by the College in connection with the attempt to develop a banana of commercial value resistant to wilt. Such a plot will also serve to try out the resistance of some existing and promising varieties which are little known and whose resistance may be unknown.

A small plot has accordingly been established and a variety is now under test, alongside Gros Michel which has been planted as a control.

Twenty-four holes were made and were planted on November 3rd with 11 suckers of Gros Michel and 13 suckers of Giant Fig, all being obtained from Grenada where Panama Disease is not known to occur. When the suckers were put in each half a pint of infected soil was scattered around it and on it, and the holes were then filled in with the soil of the plot. Suckers from the same batch were also planted in an adjoining field, but no infection was given.

The infected soil was prepared in the following way: Pure cultures of four isolations of Fusarium cubense, obtained from characteristically diseased plants of three varieties, two being from Gros Michel, were

grown for 15 days on sterilised rice in jam jars. Sifted, moist but not wet, soil from the plot was put into twenty-four pint galvanised pans covered with porous paper and cotton wool and partially sterilised either by heating for one hour in an Arnold steamer or for 30 minutes in the antoclave at 5 pounds pressure. The soil from the pans was then mixed in a large sterile battery jar, the rice cultures thoroughly worked into it, the jar covered with sterile paper and put in a dark place for three days. At the end of this period the soil was covered by a fine growth of the fungus and had the characteristic odour. It was well mixed, filled back into the pans, and each was used for inoculating a hole in the plot.

It may be said that three of the four cultures of Fusarium Cubense were obtained from Gros Michel, Silk Fig, and a local banana called Bande; the fourth was a culture kindly forwarded from Jamaica by Mr. Hansford. After 26 days several of the Gros Michel suckers from 12 to 18 inches high were showing symptoms of disease, drooping of the leaves with yellow margins and drying up of the tips. These were dug out between the 29th November and 10th December; the parent suckers showed characteristically coloured fibres, which extended into the bulbs and outer leaf-sheaths of the daughter suckers. From the red and yellow strands in the parent suckers *Fusarium cubense* was recovered regularly in pure culture. Only two plant of Gros Michel now remain in the plot and both are very backward in growth. The 13 suckers of Giant Fig came away strongly and have continued to grown steadily without showing any leaf symptoms of disease In the adjoining field both Gros Michel and Giant Fig from the same batch of suckers have grown normally.

This method of soil inoculation, therefore, promises to serve as a rapid means of testing the relative resistance of varieties, a highly susceptible kind being planted as a control.

t remains to be seen whether the Giant Fig will later show symptoms of disease, especially at the critical period when it is shooting. This variety impressed Mr. Scudamore favourably when he was n Grenada recently, and it is due to him that the present test of its resistance to disease is being made.

Another point of interest has received attention and may be referred to briefly. Three years ago an investigator in Java published a paper in which he claimed without having studied the disease in the West Indies, that *Fusarium cubense* was not the prime cause of Panama disease but was a follower of something else—a yellow motile bacterium of the *Pseudomonas* group which he found constantly present in the vascular strand of the rhizomes for all cultivated varieties of bananas in Java whether they showed symptoms of disease or not. In severe infection the external and internal symptoms closely resembled those of Panama disease and the bacterium was present in the vasculars bundles of the trunk (leafsheath). This yellow bacterium was frequently followed by species of *Fusarium* among which *F. cubense* was not found, and by other bacteria.

During the last eighteen months I have examined a number of diseased plants, mostly Gros Michel and Silk Fig, using media favouring growth of bacteria, and while *Fusarium cubense* was regularly found no yellow bacterium could be isolated from the vascular strands. It frequently happens that the vascular bundles in the leafsheaths are yellow well in advance of the *Fusarium* growth. Seventy pieces of the yellow strands from the leafsheaths of five of the diseased Gros Michel plants in the infected plot were planted out in a nutrient jelly but only two gave *Fusarium* growth. Sixty-six developed nothing, and from two which were brown rather than yellow, there grew to my surprise, in one case, a strain of *Rhizoctonia*

solani and from the other a *Phytophthora*. In the leafsheaths of three of these diseased suckers the continuity of the yellow colouring in the strands ended in yellow streaks and dots.

Twenty-eight fragments from these parts were dropped each into tubes of sterile nutrient both very favourable to bacterial growth; one showed prompt growth of a common white saprophytic bacterium; the remaining 27 gave no growth after weeks. The attempt to find a yellow bacterium in the vascular strands of bananas affected by Panama Disease has, therefore, been unsuccessful so far. *Fusarium cubense* was readily isolated from the discoloured strands in the parent bulb and the bulb of the daughter sucker of all five plants.

"BANANAS FROM SEED; VARIETY EXPERIMENTS AT THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE."

BY

PROFESSOR J. SYDNEY DASH.

The trials with bananas now in progress at the College are largely the outcome of certain correspondence which took place between the Colonial Office and the Imperial Commissioner in the early part of 1920 at the instance of the Colonial Research Committee, who were anxious to have further studies made on Panama disease as its spread in Central America was giving considerable cause for alarm. It may be recalled that Prof. Dunlop came to the conclusion that the disease was general in Stann Creek Valley, British Honduras, and also in parts of Guatemala which he had visited that year.

Following on this, the Imperial Commissioner proposed, among other things, that an extensive collection of as many varieties of bananas as possible should be made, and studied at some central station, and that efforts should be made to raise and test seedlings along similar lines to the work with sugar cane seedlings. The important end in view was to procure an immune variety or strain of commercial value to take the place of Gros Michel, so susceptible to Panama disease.

These proposals met with the general approval of the Secretary of State for the Colonies and the Kew authorities, to whom they had been submitted, and who considered it very urgent that such work should be done. Unfortunately, the idea did not find favour in Jamaica, the utility and value to that colony of the investigations outlined being regarded as doubtful. As the scheme at the time depended for its success on the financial support of Jamaica, which as it turned out, was withheld, the matter had to be dropped.

With the decision to locate the College in Trinidad, and the removal of the Imperial Department to that colony, the subject was again revived. Added stimulus was given to the importance of the work, in view of the increased activity of the banana trade and some financial assistance from the Colonial Office. Moreover, facilities were now available for a start to be made with pollination, as the Trinidad Department of Agriculture had already given consideration to the establishment of plots of the common edible banana varieties on land within easy reach of the College.

There also existed in the gardens at St. Clair three seeded species of *Musa*, pollen from which was available.

Accordingly, Prof. Mason (now Botanist in the Department of Agriculture, Nigeria) towards the end of 1922, drew up a plan for hybridization work, to proceed with the varieties at our disposal, on a fairly extensive scale. In this connection the local department generously allowed the free use of the plots referred to above, which contained the following varieties: Gros Michel, Governor (Chinese or Dwarf), Congo, Silk Fig, Sucrier (Lady's Finger) and Red—six in all. Of these the Governor and Congo are known to be resistant to Panama disease but are not favoured by the fruit companies on account of their poor shipping qualities. These were inter-crossed with each other and also with the seeded forms already mentioned, one of which is recorded as *M. coccinia*, one as *M. sapientum*, while the other is unknown. These seed bearing forms were used only as male parents, most of the pollen coming from *M. sapientum*. Between December 1, 1922 and the end of March, 1923, nearly 20,000 flowers were pollinated involving about 1,150 hands. Prof. Mason left for Nigeria in early February and the work was then taken over in its entirety by the writer, who received valuable assistance from Prof. Ashby when the former was on leave during two of the summer months.

The fruit was cut when almost ripe—three to four months after pollination—and each finger examined for seed. The total number found was 182, 123 of which were apparently sound. These occurred in three varieties, Gros Michel, Silk Fig and Sucrier. From Gros Michel, 54 seeds were obtained, 53 due to pollen from the three seeding species, and one from Congo pollen, 49 of the 54 seeds obtained from these crosses presented a sound appearance, the remainder being shrivelled or shrunken. From Silk Fig 122 seeds were obtained, all due to pollen from the three seeding species, 74 being sound. From Sucrier six seeds were obtained, none of which were good, being whitish and shrunken instead of dark and firm. The seeds were about the size of the ordinary seeded forms or somewhat smaller, and varied in shape and colour from irregularly rounded and almost black, to flat and pale brown, the latter condition being particularly noticeable in the case of Silk Fig. The seed coats are very thick and there is a cavity at the hilum end with a distinct cap. The number of seeds found in an individual fruit was usually one, three was the maximum found only once, two being unsound. Two in one fruit was found also once, one only being a normal seed in appearance. The seed was obtained an inch or two from the blossom end in every case.

All the seeds secured were sown in various ways, as follows:

(a) Ordinary light soil, covered.
(b) Ordinary light soil, uncovered.
(c) Sand, covered.
(d) Sand, uncovered.
(e) Soaked in water 35°C. ordinary light soil, covered.
(f) Soaked in water 35°C. ordinary light soil, uncovered.
(g) Soaked in water 35°C. sand, covered.
(h) Hilum incised, ordinary light soil, covered.

Sowings were made at different dates between April 8 and June 12, as seed became available. Pollinations had ceased at the end of March. In order to get some idea as to the time in which germination might be expected to take place, control experiments were started with seeds of the seeded *M. sapientum*. Those that grew germinated rather irregularly,

the first being up in three weeks, the last in ten weeks from date of sowing. As a very large percentage (90-95) failed to germinate in that time, it is possible that there had not been complete fertilization in every case, or that a very much longer time was necessary. It seems certain, however, that germination is greatly impaired if such seeds are subjected to drying even for a short time.Germination trials with seeds of *M.textilis* (Manila Hemp) in the Philippines show that the time taken for that species varies from 18 to 52 days and that seeds buried in the ground may remain alive for 155 days: also the percentage actually viable in the tests varied from 20 to 89.

Our first seedling hybrid appeared on July 7, 41 days after being sown, the medium being sand, uncovered, (d) above. Its parents were Silk Fig and a seeded form. Another germination took place on the same date 72 days after being sown, the medium being light soil, covered, (a) above. Its parents were Gros Michel (female) and Congo (male): this was particularly fortunate, in view of the resistance of Congo to Panama disease. After many hard struggles, it still continues to live. No other germinations having taken place by the middle of August, the soil in the pots becoming stiff, Prof. Ashby who kindly consented to look after this work during my absence on leave, had the ungerminated seeds removed, washed and replanted in black soil rich in organic matter. Many were found to be decayed, and 66 were actually replanted. Since that time, other germinations (all Gros Michel by seeded crosses) have taken place, until at the date of writing the total has reached 18, two of which have died. The time taken for germination of these hybrids has so far varied from six weeks to just over seven months.

Little or no advantage seems to have resulted from treating the seed in warm water or incising the hilum. It may be noted that early in the experiments one seed was treated with sulphuric acid, but as no result was obtained, it was thought inadvisable to proceed further with this treatment. It remains to be proved whether any medium exists which will hasten germination, and in this connection it is suggested that stable manure be included in future trials of this kind.

As a general observation arising from these efforts to obtain seed, it would appear that better results were obtained from those pollinations made before the dry season set in (February and March). Further information on this point and also on the many factors influencing germination will doubtless be later forthcoming from Prof. Harland, who took over this part of the work since the beginning of last October.

This brings to a close the first chapter in the history of raising bananas from seed, which the writer believes is the first attempt of its kind on so large a scale. A trial was made in Jamaica by Mr. Fawcett, who had the misfortune to lose his breeding plots in a hurricane. Great credit therefore is due to Dr. Mason for organsing hybridization work on the existing lines and who, it may be noted in passing, offered a reward of $100 to the two assistants he trained in pollinating, if seed was secured.

With regard to the establishment of an extensive collection of bananas, which had been envisaged when the scheme for banana work was first put forward, efforts are now being made to carry this out at the College, where a piece of land has been set aside for the purpose. At the present time, only those varieties procurable in the West Indies and British Guiana are contemplated. From British Guiana some sixteen varieties have already been obtained, many of these of eastern origin introduced some years ago through Kew. From St. Clair experiment station a small collection of seven has been obtained. These, with the three seeded

forms, also from St. Clair, the six common edible kinds previously referred to, with six miscellaneous kinds, including plantains from other local sources, and the Grenada Giant Fig a large banana which gives promise of being resistant to Panama disease, make a total of 39, in addition to the 12 seedlings of the seeded *M. sapientum* raised at the College. Dr. Hill has also very recently presented us with a plant grown from seed of an edible fruit collected in Nigeria.

The above should provide material for study and for hybridization with the special object in view, namely, disease resistance and commercial qualities. It is hoped shortly to extend these plots to include any hybrids already obtained, which may have made sufficient progress. At the same time, studies are being made on mode of suckering, best types of suckers for planting, and their relative fruiting values. Thus it will be seen that the work as at present planned, falls into three parts —genetic, agronomic and mycological.

One part of the paper is rather technical, but I hope it will interest the technical gentlemen present (laughter).

Sir Francis Watts: Prof. Ashby has given us a succinct amount of the attempts made to find a highly disease—resisting banana plant. We have made a beginning, and we propose to drive along steadily towards the goal we are aiming at. It is hoped to get a lot of original information with regard to the banana disease, and the plan also embodies the best means of speedily determining whether certain banana plants are resistant or non-resistant to the banana disease, and also to get a determination with regard to other diseases of bananas, fairly well known, and sometimes confused with banana disease, at any rate sometimes in Trinidad. We should attempt, I think, to conclude our papers on banana disease before indulging in any general discussion, if such discussion is desired. I will now ask Prof. Harland to read his paper, and conclude our papers on bananas.

Dr. Harland read a paper on "Botany and new types of bananas."

Sir Francis Watts: Dr. Harland's remarks I think are extremely interesting in more senses than one. This is one of the few occasions in which the agricultural scientist appears in the role of prophet. He is not prophesying the exact kind of bananas that may be developed, but he says to us that if that work is carried on and developed on right lines, there will be new kinds of bananas, many new kinds of bananas, that will be suitable for different classes of the trade, and probably bananas that will be acceptable for markets of far wider ranges than are apparent at present. This is a matter of great consequence because hitherto we have been content in building up an enormous industry based on one type. You see what the capacity of that industry is, in the production of this colony and the neighbouring portions of the mainland. Now look into the work that is being done at the Imperial College of Agriculture, and you will see what may happen. If these bananas could be diversified greatly, a different class of consumers could be built up, perhaps some willing to pay a fancy price for fancy kinds. If this could be done then the future would be full of hope for the industry. If we could widen out the possibilities of our banana trade it would become more important to the producing islands in the near future. It is not wise to prophesy, as one often finds out, but I do not think that Prof. Harland has gone beyond the limit, or that his views are far-fetched in telling us what he has. We know what is being done at the Imperial College of Tropical Agriculture in the West Indies. This is one line of work that is being carried on now and it is progressing at present. The College has

only been in existence 18 months, and what has been already achieved promises very well for work in the future, along with the other lines. It is not wise to prophesy; the researches so far have not gone beyond the confines of prophesy, but the experiments have been wonderfully successful up to the present, and augur very well for the work that can be done in the future. We have time, and if anyone wishes to ask questions about the banana industry—if anyone wishes to get any information—I am sure the various speakers will answer them. If not, it will be for us to decide whether we can clear up other papers in the time left at our disposal.

Mr. Wiltshire: If I may be allowed to say something, I would like to congratulate the Agricultural Department on its successful attempt on banana disease. I think a great deal is due to their efforts for the success achieved. In the second place, I want to make a suggestion in regard to the germination of seeds and the disease. In recent work in Germany in connection with fungicides, they have found that certain preparations have resulted in marked stimulation of seeds of various kinds, and possibly some utilization of one of these fungicides may be useful in this special field.

Sir Francis Watts: In connection with bananas we have had quite an interesting discussion. If there are no further remarks we can go on with our other business.

Mr. Stedman: I was hoping that some one would say something practical with regard to the banana industry before I rose myself. I very much regret it has not been possible for me to agree entirely with all that has been said, and that it was not possible for us to have perused the paper of Mr. Ashby. The papers read have been very interesting but I take it that the points they cover are limited to the experiences of the two gentlemen in certain circumstances. We have in Jamaica an Advisory Committee on the Banana Industry, which has been conducting certain experiments which have been very important. Had it been possible for that committee to have perused the papers before they were read, there might have been some modifications in the papers, and some extensions in other directions. As our friends from the other West Indian colonies are very interested at present in the banana industry, we regret very much indeed that it has not been possible to prepare a paper, apart from the technical side, on the practical side as to what is being done in the colony with regard to the banana industry and the problems to be met. I myself have some experiences which I do not wish to refer to. I think myself the Conference would be interested in the steps that have been taken by the Committee, and I am sorry it has not been possible to go into details with regard to it. As our friends from the other West Indian islands are interested in the matter, I do not think the papers should be presented to-day as conclusive of the whole matter. I think that my friend, the Director of Agriculture, with whom I have been fighting for many years although we are good friends now, might be able to prepare a paper which will be of interest to the whole of the West Indies, who are looking to establish the banana industry. I think this is a matter that might be taken up with a good deal of profit to the other West Indian colonies.

Sir Francis Watts: If any further material can be put forward we will be glad to hear it. We cannot discuss material which is not before us.

Mr. Stedman: If we are given the chance you will get the material

Sir Francis Watts: There might be a good deal of disagreement on this matter, of our bananas——

Mr. Stedman: Doctors differ and patients die.

Sir Francis Watts: I don't think we can discuss this matter any further this afternoon. It is now four o'clock. We have been sitting from 11 o'clock and we have very litlle more time to consider the matter. We will now adjourn until 9 o'clock to-morrow morning.

The Conference then adjourned until 9 o'clock on Wednesday, 30th January.

THIRD DAY.

The Conference resumed its sittings at the Ward Theatre, Kingston, at 9 a.m. on Wendesday, January 30th, 1924, Sir Francis Watts, K.C.M.G., Imperial Commissioner of Agriculture for the West Indies, presiding.

Before the day's programe was proceeded with, the president announced that there would be a demonstration of Live Stock at Hope Farm from 7.30 to 9.30 a.m. next day; consequently, the Conference would not meet that day until 11 a.m. It was also decided to hold future meetings of the Conference at the rooms of the Jamaica Institute.

Proceeding, the President said that Mr. W. Nowell who was down on the programme to read a paper on the Experimental Work at River Estate, Trinidad, was indisposed, and Mr. Barnardo had undertaken to put forward his conclusions on the Cacao Industry, and the Conference would therefore take his paper first.

Mr. Barnardo: Owing to the indisposition of Mr. Nowell, I have been asked to read a few notes. This paper which I will read was prepared by Mr. Freeman, the Director of Agriculture of Trinidad, and was read at the demonstration which was held on River Estate on the 11th of October last.

"WORK ON CACAO AT RIVER ESTATE"

BY

W. G. Freeman, F.L.S., C.M.G., Director of Agriculture, Trinidad.

As they were all only too painfully aware, cacao planters in the colony are passing through very anxious times. The world's market price of cacao was very low. Doubtless, that was due to more than one cause ,but prices of most products were largely regulated by supply and demand. Taking the last nine years (1914-1922) they found the world's production of cacao given as 149,900 and the consumption as 103,900 tons. There was hope for a better condition of things, inasmuch as in the years 1921 and 1922, although production was higher in both years than in 1920, consumption increased still more, and these two years reduced the balance of over-production 51,000 tons, i.e., whereas at the end of 1920 the excess of production over consumption was 97,500 tons; at the end of 1922 it was 46,400 tons. With a settlement in European conditions it was probable that consumption would shortly overtake production, and so result in better prices.

So far as production was concerned they had to face the fact that our competitors were not foreign countries, but other parts of the British Empire, who naturally get as they did, a preference on British products. The British Empire produces the greater part of the world's cacao, and yet, instead of being able to control it to the best advantage of the Empire as a whole, it is forcing production to the disadvantage of all concerned.

Compare the figures for production and consumption in the British Empire for 1914 and 1922..

	1914 tons	1922 tons
Production ..	103,000	235,000
Consumption ..	32,000	59,000
Surplus to be disposed of	71,000	176,000

In 1922 the British Empire had over 100,000 tons of cacao more than in 1914 for which it was necessary to find markets outside the Empire, at a time when the purchasing power of most other countries was low. It was admitted that the Gold Coast, by far the greatest producer in the British Empire at present, can put cacao on the market at a very cheap rate. Also, that although it is an inferior quality of cacao, it will naturally, because it is cheap, be used to a larger extent, so far as it is practicable. To enter into successful competition two courses seem open: (1) To produce a cacao of a quality for which manufacturers are prepared to pay a higher price, (2) To increase our profit by producing larger crops on the same acreage, and reducing cost of production.

Improvement in quality was being attempted in one or two cases in the Colony by the selection of cacao. It is not immediately practicable by those who have already established estates, and in their cases attention has to be restricted to producing as high a grade of cacao as is possible on lines which have been urged recently by the Cacao Planters Association, namely:—

Removal in breaking of unripe diseased pods.
Cleanliness in the sweat boxes.
Careful fermentation for 8 days.
Cleanliness in the drying houses.
Removal of waste, and broken beans, etc.

The second point, can we increase our profits per acre, is worthy of careful attention by all planters.

They had had demonstrated to them once again to-day, the fact that cacao trees vary greatly in their yield—there are naturally heavy, medium and poor bearers They had also seen the experiments in progress to test how far these bearing qualities are hereditary. In one field you visited there were 187 young trees, seedlings of one parent tree, No. 4927 on the estate. That tree has a remarkable record. Its yield of pods per annum for the last eleven years has been:—

1912/13	404
13/14	328
14/15	299
15 16	294
16/17	234
17/18	324
18/19	495
19/20	385
20/21	224
21/22	231
22/23	392
	3,610

This is an average yield of 328 pods per annum. It is not one of the best varieties and 13 to 14 pods are required to yield 1 lb. of dry cocoa bean. Allowing 14, the yield is 23½lb. of dry cocoa a year, 15 bags of cacao to the 1,000 trees, or one bag of cacao from seven trees, so that if planted 15ft. by 15ft. giving 180 trees to the acre, the yield would be 26 bags per acre, in place of the more usual 3½ to 4 bags.

Commercial development of high yielding strains has been accomplished with other plants, and as you are aware, the Department holds the view that similar success with cacao is possible. The six acre plots of seedling budded and grafted trees from selected heavy bearers, and results already obtained on Mr. MacClean's estate at Siparia with budded plants from heavy bearers supplied by the Department are encouraging.

There is also the line of work under trial at River Estate of cutting out the trees which yield so badly that they are an expense and not a profit to the estate. That with reasonable attention to cultivation and sanitation, including shading, returns much above the average can be obtained is shown by the pickings this year in Field 5 where from 1,500 trees (500 shade, 500 partial and 500 no shade) 8 bags per 1,000 trees were obtained at each of three successive pickings, i.e., 24 bags per 1,000 in three pickings.

Increased Production.—The practical point common to these various lines of work, is the endeavour to find the means of producing more per tree and per acre. It costs as much to cultivate an acre of poor bearing trees as an acre of heavy bearing trees, and from the poor bearers the profit is obviously much less. People who invest money in shares are careful to choose those which pay the higher rate of interest, but in cacao many continue to invest money apparently without considering whether they are getting 20, 10 or 5 or nothing per cent. on their outlay.

The other way to obtain more profit into cheaper production.

From experience with other orchard crops and also with cacao it was established that cultivation of the soil is beneficial. Hand forking is however, expensive, costing about $9.00 an acre. You have seen to-day a plough at work in cacao. The experiment was a new one, but under conditions at River, 2 acres can apparently be ploughed and subsequently gone over with a cultivator, at a cost of about $1.50, say $2.00 or $1.00 per acre. Reduction of shade which they had been practising and advocating for some time, should be accompanied by increased cultivation. With the use of animal-drawn ploughs and cultivators this will be practicable with a large reduction in cost and increase in efficiency, for hand forking was often very badly done. They hoped to develop that line of work where conditions were already suitable or could be made suitable.

With regard to the question raised by the President at the meeting as to the actual cost of production there. Mr. Scheult had just given him a note. It was prepared up to September 30th. Up to then they had reaped on the estate 1,180 bags of cocoa. Expenditure including Manager's salary, worked out at $10.09 a bag. If they included experimenting, etc., it came to $10.68, and other things being included would bring the total cost of production to no more than $11.0 , but the actual cost worked out at $10.09 per bag.

Mr. Barnardo proceeded:—The facts as stated in the paper clearly prove that taking it at an average the last 2 years' consumption has overtaken production. This is accounted for by reason of the fact that there were large stocks held both in America and in Europe. In Trinidad the chief thing in the cultivation of cacao is to plant with an extensive amount of overhead shade. The question of cultivation

by ploughs can only be carried on an Estate that is so situated that you either have no shade or very little shade. It seems that the only successful lines on which we can hope to increase the price of cacao is to put it on a more marketable basis. We have to produce cacao for a market that is prepared to pay the highest price. I do not want to say anything about the monopoly, but at the same time it is rather optimistic to think that if we could produce a better class of cacoa we could get a better price. There is undoubtedly a poorer class of cacao produced in the world. I am speaking of the West African cacao—so that really everything so far as the question of the price of cacao in the world's market is concerned, depends on the price of the West African cacao. Consequently, the Agricultural Society of Trinidad have felt that the the only chance of getting out of this very depressed condition which the cacao market is in at the present time, is to work on different lines —to try and get a Conference called in London this year of the Empire cacao producers of the world and others concerned in the trade, at which we could come to some sort of working agreement in some way or other, and at which we could get the manufacturers to aid us and fix up some scheme for bettering the present conditions; and we think that the basic lines would be to get the manufacturers to come in on a world-wide campaign, such as is done by other people—by the raisin growers of California and the fruit growers. In this plan and working on these lines, we would not antagonize the manufacturers in any way but would rather be banded with them, because it would help them to sell a better article.

The President: This paper has touched on some of the work that is being done in Trinidad in connection with the cultivation of cacao, and it has also touched on the general position of the world's outlook towards surplus cacao. The industry is really in a serious condition owing to the cheaply grown West African cacao, and something must really be done to make the industry more profitable to the West Indies. This is a subject which affects Jamaica, Trinidad and Grenada very seriously. Mr. Barnardo has put forward several suggestions to improve the position. I think an increase of yield will be found in Trinidad and also in Jamaica. The increased consumption of cacao, will, I think, be the outcome of the Conference which it is proposed to hold in London this year. At the Conference it is suggested that all parties concerned should be taken into council with a view of aiding the industry and putting it on a better footing. We want to grow a new kind of cacao which the manufacturers will see and ask for. I hope it will be possible for us to produce some which the manufacturer will want. Before going further with the general discussion on this subject I would ask Dr. Harland if he would lay his views on the Botanical Researches on cacao before us.

Dr. Harland then read the following paper:—

"STUDIES IN CACAO.—THE METHOD OF POLLINATION."

BY

S. C. Harland, D.Sc. (Lond.)

Introduction.

The precise method by which the cacao flower is pollinated has been the subject of considerable discussion in the past by various workers, but no exact series of experiments have hitherto been carried out.

Uzel, cited by Wright, was of opinion that the flowers were pollinated by thrips, while Green regarded the common aphis as playing some part as a pollinating agent. According to Van Hall, there are many facts which indicate that neither thrips, aphis, nor ants play a role of any importance in pollination. His reasons are :

1. The above insects do not invariably occur on cacao trees.
2. Cacao invariably exhibits strong inter-crossing, i.e., a field of cacao consists of a mixture of hybrids, and this indicates that pollen may be transported from one tree to another, either by wind, or by flying insects.

Van Hall finally cites the investigations of von Faber which were carried out at Buitenzorg, and considers the whole question solved by the latter's experiments. Von Faber considered that the structure of the cacao flower did not eliminate the possibility of self-fertilisation. The long and supple flower stalk facilitates the swinging to and fro of the hanging flower by the wind. Experiments proved that by this movement pollen easily falls from the anthers on the pistil of the same flower and it could be demonstrated that isolated flowers were easily pollinated in this way. Self-pollination may therefore be regarded to be the rule in the cacao flower. When, however, neighbouring trees stand close to each other, it is also possible that the pollen falls from the hanging blossoms and settles on the pistil of flowers of the neighbouring tree. In this way cross-fertilisation is possible when the trees stand in close proximity as is the case in all plantations.

By far the best discussion of the agencies by which the cacao flower is pollinated is given by G. A. Jones. He is opposed to the view of Von Faber and considers that the structure of the cacao flower is such as to render self-pollination almost impossible, and is also quite unsuited for wind pollination. He arrives at the view that the only remaining means of pollination is by the agency of insects Numerous experiments were carried out, in which single flowers were enclosed in muslin bags, with no insects present. In no case was there any setting of fruit, and led the author to believe that without outside agency pollination cannot take place. The next series of experiments was with flowers which had a number of small insects on the stems or where these insects were introduced by hand. The flowers were enclosed in such a way as to keep out ants. No case of pollination resulted.

Jones finally concludes that "in Dominica the cacao flower is largely pollinated by the agency of ants, which are attracted to the flower by the secretions of the insects named above, and in the process of nursing these insects, come into contact with the pollen and transfer it to the stigma. (Jones, B.A. The structure and pollination of the cacao flower. West Indian Bulletin, Vol. 12, p.p. 347-359.)

To sum up: there is a wide variance of opinion in previous writers in regard to the manner in which pollination takes place in cacao, and the need for a more exact study of the question is self-evident.

The Experimental Results.

To what extent does pollen reach the stigma of cacao flowers?

An examination was made of the stigma of 100 randomly selected open flowers, employing a binocular microscope, with the following results:

No trace of pollen ..	93	2 pollen grains	2
1 pollen grain ..	4	Many pollen grains	1

It may be concluded that the pollination of cacao flowers is the exception, and that there is no insect which makes a special business of pollination. Indeed, all the evidence is in favour of sporadic and accidental pollination by insect agency.

To what extent is hand pollination of flowers efficient in causing setting of pods?

Experiments were carried out in which over a period of several weeks, a number of flowers were pollinated by hand, recording at the same time the behaviour of an equal number of controls. Daily observations were made on the behaviour of the pollinated and unpollinated flowers, flowers opening since the previous evening being used for experiment. The results are presented below:

Table 1.

No. of observations.		Number of flowers remaining on the trees after the following number of days.										No. of pods set.
		1	2	3	4	5	6	7	8	9	10	
304	Pollinated	103	92	74	61	37	26	22	22	21	20	20
304	non-pollinated	29	16	7	3	1	0	0	0	0	0	0

The conclusion may be drawn that under the conditions of the experiments artificial pollination is instrumental in causing the setting of fruit. Further, the cause of the non-setting of control flowers is probably lack of pollen on the stigma. The vast majority of cacao flowers drop off without being efficiently pollinated.

Does self-sterility occur in Cacao?

In many trees, such as apple and cherry, certain varieties are self-sterile, i.e. are incapable of setting fruit with their own pollen. Numerous observers have pointed out the indisputable evidences of natural crossing in cacao, but evidence on whether self-sterility exists has so far been lacking. A large number of flowers in a representative group of trees have been made the subject of experiment to decide this point. The results of the experiments will be found in Table 2.

Table 2.

Results of experiments on self and cross-pollination.

Number of observations	Treatment of flowers.	Number of flowers remaining after following number of days.										No. of pods set.
		1	2	3	4	5	6	7	8	9	10	
547	Cross-pollinated	251	214	182	129	71	41	31	26	20	20	20
547	Self-pollinated	255	219	182	118	72	47	36	33	28	28	28
547	Controls	56	15	9	6	4	4	1	1	1	1	1

It will be seen from the above that the behaviour of cross-pollinated and self-pollinated flowers is practically the same, while the behaviour of control flowers falls into line with the result of control flowers in Table 1. Cacao therefore exhibits no sign of self-sterility, a fact which renders the production of pure strains from seed a relatively simple matter.

To what extent is cacao pollinated by ants and (or) aphis?

Examination of a number of cacao flowers collected at random will show the presence of aphides which cluster on the stem and are attended by small red ants. As both these insects have been suspected of being concerned in pollination, the question has been gone into. A number of flowers affected by aphis and ants were tagged daily, and a similar number on unaffected flowers tagged at the same time Daily observations were then made as in previous experiments. The results are summarised in Table 3, below.

TABLE 3.

The effect of the presence of ants and aphis on the stems of Cacao flowers, on the setting of pods.

Number of observations.		Number of flowers present after the following number of days.										No. of pods set.
		1	2	3	4	5	6	7	8	9	10	
732	Aphis & Ants present	176	108	72	48	344	23	17	13	13	11	11
732	Aphis & Ants absent	74	31	17	9	7	5	4	4	4	4	4

These observations show that not only are more pods when the flowers are attended by aphis and ants, but that the rate of loss of flowers over the period of observation is consistently less. It seems probable from the results of previous experiments that the majority of flowers in both sets have been inadequately pollinated,but that pollination was more efficient in the ants and aphis group. It is possible, however, that aphides may exert on the flower some kind of physiological stimulus which retards abscission, and this might have a beneficial effect in setting, by prolonging the time during which pollination is possible. The difference in the number of pods set in the two series is undoubtedly statistically significant, though further work on the subject is needed.

What effect has the elimination of crawling insects on pollination?

A mixture of pitch, rosin, rosin-oil and coconut oil when applied with a brush to the stems of cacao trees forms a barrier which no crawling insect can cross. Trees were banded with the mixture to include a section of trunk about 3′ wide, and a kerosene emulsion spray was then applied to the isolated portion in order to ensure freedom from crawling insects. Flowers one day old were then examined for presence of pollen on the stigma in three groups.

A. *Flowers from section of trunk protected from crawling insects.*

Out of fifty flowers, forty-nine had no pollen whatever on the stigmas. One had a mass of pollen grains on the stigma numbering more than 100 grains.

B. *Flowers from unprotected section of trunk unattended by ants and Aphis.*

Out of fifty flowers, twelve showed no pollen either on style or on stigma. Of the remainder some showed a few grains of pollen on the style with an occasional pollen grain on the stigma, while only one showed enough pollen on the stigma for adequate fertilisation. The flower had a large mass of pollen on the stigma consisting of 100 or so grains.

C. *Flowers from unprotected section of trunk, attended by ants and Aphis.*

It was hoped to show in this series a significant difference from B, in the extent to which pollen occurred on the stigma, but examination of fifty flowers showed only two to be adequately pollinated by a large number of grains on the stigma itself. The extent to which pollen was present on the style, with occasional sporadic grains on the stigma appeared to be much the same as in B.

Discussion of results.

The important points established are these:—

1. The elimination of crawling insects from attendance on the flowers shows that this class of insects is responsible for the sporadic distribution of occasional pollen grains on the pistil. The flowers with abundant pollen on the stigma, four in number, have evidently been pollinated by some unknown flying insects, of which nothing is known at present except that it is possibly of the pollen collecting type. Whatever its nature, it is, under the particular conditions of the experiments, extraordinarily inefficient as a pollinating agent, and it is clear that efficient pollination of flowers as a preliminary to setting of fruit takes place in less than three per cent. of cases. Whether more efficient pollination occurs in other districts has still to be determined.

The individuality of the tree as a factor in the setting of pods.

In carrying out the experiments on artificial pollination the results of which have been discussed, great variation was noticed in the ability of different trees to set fruit, even when thoroughly pollinated. At the commencement of the work some of the trees possessed a fair number of pods up to 30 or more in all stages of development. Other trees, apparently equally vigorous, were entirely barren. The general conclusion from the experiments was that if trees were barren it was impossible to cause the setting of fruit by artificial pollination, while if the trees had pods already, more could be caused to set by this means, though whether the resulting pods would arrive at maturity remained an open question. The inability of trees to set may be due to a variety of causes, but it has been established by the Trinidad Department of Agriculture in their River Estate experiments that high yielding and low yielding trees maintain an inherent capacity to yield well or poorly over several years. The limiting factor in yield is probably the genetic make-up of the tree, which determines whether the tree is inherently a good or bad "setter". Bad setters will not yield well, however favourable the external conditions of soil or climate, while the yield of good setters will vary with these conditions, but will respond favourably to good agricultural practice.

Professor Harland in emphasizing his paper said: It must be observed that you get two kinds of trees, one of which will produce a large quantity of pods and the next one will produce no pods at all, but if you have a poor bearing tree it tends on the average to be a poor bearing tree. On the other hand, a tree which is a heavy bearer, in spite of different seasons, will always give a good yield. Now that seems to indicate that poor bearing or heavy bearing is a matter of heredity,

and is one of the questions that we have to consider when going into the matter of good-production and non-production. The investigation of the reason why fruits are set on one tree and not on another requires to be gone into. Another question that we have to deal with is to find out some method of eliminating the insects altogether. These observations were made very early in the morning. Having disposed of the question of pollination, we dealt next with the individuality of the tree, and we arrived at the conclusion that one of the main causes of non-production is the inability to set fruit after pollination. Now, can we find an analogy? In cotton we find exactly the same thing. One row of cotton will have a great many flowers, and in another row you will get none at all. In view of these results I have almost come to the conclusion that experiments with budded cacao are very liable to be misleading.

The President: We have listened to a very interesting paper from Dr. Harland, and no doubt some of the gentlemen present would like to ask questions on the remarks that have been put forward.

Capt. Hill: I would like to ask what is the proper time to fertilize the cacao flowers, and whether bad yielding trees are what they are because they produce few flowers. I also raise the point as to whether the flowers of the cacao tree must be pollinated in order to produce bigger yield. It is important to remember that the cacao is not a native of this part of the world, but has been introduced here, and the question is whether the proper kind of insect exists here to fertilize such a flower as the cacao. Owing to the construction of the flower, it seems quite clear that it must be fertilized by some insect and not by the wind. I would like to know whether there is any evidence indicating that the insect went about the flower; whether pollen was found scattered about the flower as well as the stigma. It is characteristic of trees and plants generally to always produce a lavish amount of pollen, more than can be used, and the cacao tree, although it produces many flowers, does not use more pollen than other trees in the vegetable kingdom.

Dr. Harland in replying to the points raised by Capt. Hill said: The bulk of evidence regarding the time of pollination of cacao is that it took place in the early hours of the morning by some nocturnal insect. The low yield of certain cacao trees is apparently not due to a deficiency of flowers, because such trees often produce large quantities of flowers, all of which fail to set fruit. The fact that a cacao tree produces a large number of pods is no certainty whatever of its ability to produce a high yielding progeny.

Capt. Hill: With regard to the fertilizing of these trees; perhaps if it were done at 2 o'clock or 3 o'clock in the morning, better results might be obtained

Dr. Harland: I have done it from 3 o'clock in the mornings until when the flowers are opening, and the general conclusion that I have come to is that the cacao stigma is adapted for a very wide area. It will continue for about $2\frac{1}{2}$ days.

Mr. DeLamothe (Grenada): I may say, Mr. President, that we in Grenada have never noticed that difference that we hear of in Trinidad. The general statement that some trees are successful bearers, whilst others are poor bearers is a fact, but we find that in Grenada we make all the trees to be fairly good bearers, and that is by the use of manure. We have watched these experiments on our estates very thoroughly, and we are hoping that good results will accrue from them. Of course, we have always planted there our best trees, but to say that our cacao will

improve by budding the trees which are lost, is up to now a matter of speculation. In the matter of cultivation I think we are ahead of Trinidad, because we go in far more for manuring and working up the lands than the people do in Trinidad. One of the points to be observed in working on the hill sides, is that forking should be done at the beginning of the dry season, and not at any other time: otherwise you might do enormous damage to your cultivation. In Grenada we indulge more in training and mulching. One point I would like to emphasize is the great advantage of liming in the elimination of pests. I have introduced this in my plantation over and over with good results, but not only is this liming useful to the soil, but it has a marked effect in destroying all the insect pests. I attach great importance to this matter because it has been of great assistance to us in Grenada. Now, with regard to what Mr. Barnardo has said, we have always been told to improve the quality of our cacao, but I think that the buyer is more to blame than the planter. If you produce a good class of cacao, you get very little more for it than the inferior class, and thus in Grenada the small man refuses to take any great care in the cultivation of his cacao, and when he is asked the reason he says "What is the good of taking any great care in the cultivation of my cacao, when as a matter of fact I get no more for it than if it were of an inferior quality?" We have attempted in Grenada to pass a resolution to eliminate any unfermented cacao leaving the island, but no action has been taken, owing to the habit of the small people, who think it is no good sending forth better cacao, because they will not get any more for it.

Mr. Barnardo: I think I am right in saying that with the exception of one planter, generally speaking the cacao planters in Trinidad are regarding the experiment with a great deal of suspicion, and are not satisfied in their minds that it is going to be successful, or that it is going to increase the yield; and at the present time they are not planting on a large scale. As a planter I would like to confirm what Dr. Harland has said about some trees having plenty of flowers and never setting any fruit. Now in a batch of 15 to 20 trees there was one tree on which I do not remember seeing any fruit setting at all.

Mr. DeLaMothe: We experience the same thing in Grenada and what we do there is to get them out altogether.

Dr. Harland: I must say that as far as I know scientific experiments are going to be carried out on these lines. Mr. Holstead has called attention to an aspect of the matter which must receive attention in the future.

Mr. Farnell: I would like to ask what exactly is the quality of the cacao. Have any experiments been made or have any figures been ever given to the public showing the difference between the West African and the higher grade cacao?

Prof. Ashby: We have not done any work on the fermentation of cacao at the college yet but I am hoping to take up the matter shortly. There is still a great deal to be found out. I think the producer will be put in a position to control to a greater extent his product and to adapt it to the requirements of the manufacturer. That is all I can say in regard to this matter at the present time.

Mr. Barnardo: Now with regard to the question asked by Mr. Farnell, we have found that the manufacturer wants so many things. Before the war France bought nothing else but unfermented cacao. Now to-day she practically will not buy any unfermented cacao. Then again, there are certain manufacturers who specialize in a certain product, and what they require is known as spiced cacao, and we in Trinidad have

been approached by two of the biggest manufacturers, asking us to plant Ariba cacao, but unfortunately this Ariba cacao has rather poor bearing qualities, so we will not touch it. Therefore, I do not think we can work on any one special quality which the manufacturer wants. At one time every manufacturer in the United States would have Trinidad cacao in his formula, but to-day, with the exception of one manufacturer, they do not use Trinidad cacao in their formula. So that it will be seen that it would be almost impossible to work up any one special kind of cacao. Then what is it the manufacturers really want? It is immaterial to him what he gets. You can give him the nastiest stuff and he will be quite willing to take it.

Mr. Cousins: With regard to "Ariba" cacao, we have grown it at Castleton, and those who are interested in cacao will see it growing up there. The sort of cacao which they grow so well in Grenada will grow at Castleton Gardens and it is very important for each country to choose for cultivation cacao which is suitable to that country, and people should not be anxious to grow this high class cacao which is very difficult to grow, and might not give the best results.

In reply to *Mr. Barnardo, Mr. Cousins* said: I have advised the planters not to select trees that grow with great vigour but give poor results in crop, and therefore I would not advocate the planting of this particular kind of cacao, because it happens to have a big reputation somewhere else.

The President: Is there any evidence as to the character of the beans which this imported tree produces? What kind of beans do you get from it?

Mr. Cousins: You get a light coloured bean, a high class bean. As a matter of fact, we do not take the thing seriously. We came to a conclusion on the matter and I think that we were right.

Dr. Harland: As in the case of cacao, you can take cotton to the spinners in Lancashire, and you will find that they do not know the kind of cotton they want. Take the enormous Lancashire industry. The botanist has had to step in and tell the cotton manufacturer the kind of cotton he wanted and why he wanted it. It is the same thing with cacao. With regard to possibilities, coming back to this Ariba cacao, I have been making enquiries, and I was told that the quality of the cacao was due to the situation in which it was grown. What we really want is a constructive system of investigation, in order to be able to say definitely what quality of raw material is required for commercial purposes.

The President: We have had an extremely interesting discussion on cacao production and the qualities of cacao and we must thank Dr. Harland for his very illuminating paper. Dr. Harland has initiated a system, an extensive system, of the cultivation of large crops, as extensive studies are taking place in wheat and apples, and if any improvement takes place in these matters it will come as a result of these extensive studies. Dr. Harland has put forward many points which will require workers to carry out. He has cleared up many important points; he has pointed out that it is quite possible that in grafting cacao you are not getting the same results by carrying one kind of bud to another kind of tree, and he has pointed out how cautious must be the examination before each commercial undertaking should be carried out. More knowledge should be obtained before this is done. It seems to me that it is quite conceivable that we may have to resort to the artificial pollination of cacao, as we have done with regard to vanilla. I remember the time when we thought that hand pollination

of cotton was impracticable, but we have had evidence of the great benefit and large production which resulted from it, and it might be possible for us to have a hand pollination of cacao. Now should we not study what has happened in South America, and the insects that are there doing damage to cultivations? There are heaps of ways in which we think Dr. Harland's paper will help not only the scientific production of the products, but also in achieving immediate commercial results.

"THE CACAO PROBLEM IN SAINT LUCIA."

BY

A. E. Walters, Agricultural Superintendent, St. Lucia.

All observers who have an interest in practical agriculture cannot but view with dismay the present unfortunate position of the cacao planter; it is common knowledge that cacao production in St. Lucia and other West India Islands is at present a proposition that no wise planter views with equanimity, and such estates as have produced cacao in large amounts find themselves with unsaleable product on their hands: such a state means disaster to the cacao planter.

It is therefore in an endeavour to solve this pressing problem that the following notes are subscribed:—

In view of the negligible sales of cacao beans dispatched to English markets from this island, it has become urgently necessary to consider how conditions can be brought into existence whereby such produce can be made marketable, in some form or other.

In the first place, it must be considered whether the product is at fault; —this, in the case of St. Lucia does not appear evident. First grade estate cacao as produced here, consists of clean, good sized, well fermented beans; this is termed "fair" to "good" by the London market.

Such high standard produce, however, is commonly mixed with inferior beans, and the whole sold as "fair"—a low or middle class product; this unfortunately is in demand more than the high grade cacao, thus the art and care expended on the best product results in monetary loss, or the difference in price is not enough to encourage production of high class cacao.

Secondly, such continued losses on produce discourage the planter; cacao now in the words of the planter, is said to be "hanging on" in the hopes of better times; such a state means neglected cultivation, and further destruction of cacao plantations to give place to other crops.

Since West Africa can produce large amounts of cheap cacao, of a grade which has not yet been determined as being better than West Indian Estate cacao,—and since to make good chocolate and cacao a high grade product must be employed—there must be some profitable outlet for the cacao produced in the West Indies.

Thirdly, have the finished products, chocolate and cacao been considered on a business footing? It would seem that with locally produced sugar, and raw cacao to hand, it should be possible to take the raw product further, and produce commercial confectionery and beverages on the spot; such at present seems to be the one hope of the cacao planter, and with co-operative methods it may attain achievement.

Against this possibility, however, arises the caution and conservativeness of the average planter, who with small capital does not care to risk this and launch into the unknown of experimental trial and possible loss.

Apparently, a certain amount of *chocolate* is manufactured in at least one West India island; as far as the writer's experience goes, it is a harsh, somewhat gritty product, which could never compete with the smooth palatable confectionery imported from overseas. There is also produced in small quantities in St. Lucia, unsweetened chocolate sticks; these consist of the cocao bean ground and rolled into sticks; these sticks can be used to make cocoa beverage by dissolving in boiling water; as, however, none of the crude cocoa-fat is removed by heat, such beverage is somewhat greasy and not attractive in apperarance, although the natural flavour of the cacao bean somewhat compensates for these objections. With regard to the above mentioned manufactured *chocolate*, there is no special flavour attached to this local product, whereas each home manufacturers product has its own distinctive taste, in addition to which are the delicately flavoured chocolates of many varieties, deriving their flavour from *essences* natural or chemical. Such essences originate largely within the warmer regions of the globe, viz:—spices and tropical fruits from which extracts are obtained.

It would therefore appear that all the natural products necessary for good chocolate-making, are readily obtainable from local supplies, or can be produced, but it is also obvious that a high class article must be aimed at, if competition on even a small scale with chocolate-making firms can succeed.

With regard to *cocoa powder*, the difficulties of manufacture do not seem so great, although the writer has no practical experience on these lines; he desires, however, to have an authoritative announcement on the problem stated herein, and although it may be observed that the mechanical plant for such chocolate and cocoa manufacture has not been touched upon, this should not be allowed to militate against a favourable discussion of the possibilities outlined here.

The writer in making the above suggestions for consideration by this Agricultural Conference, begs to apologise for lack of statistical data in connection with cacao production and chocolate making, as in the short time allowed for preparation of notes, no very comprehensive scheme could be worked out; the following London Market Reports on sales and the Cacao exports from St. Lucia are quoted for reference:—

LONDON MARKET EXTRACTS.
COCOA.

Quotations.—Saint Lucia. Grade—Fair to Good.			B.W.I. Stocks held other than Trinidad and Grenada.
Year 1923.	Per Cwt.	Bags.	
February 19th—	44/- to 50/-	12,763	Sales at 49/—51/-
March 26th—	44/- to 50/-	13,588	Part sold at 47/- to 50/- Common 41/-
April 30th—	38/- to 49/-	13,568	998 bags offered few lots sold.
June 11th—	38/- to 48/-	13,589	No sales.
June 27th—	45/- to 53/-	8,957	9 bags offered and sold. Fair 40/- to 42/-.
July 18th—	38/- to 47/-	13,853	No public sales.
October 1st—	36/- to 44/-	13,042	No public sales.

EXPORTS OF RAW COCOA, FROM SAINT LUCIA.

Year.	Quantity Cwt.	Value £
1918.	35,610	85,026.
1919.	16,370	75,192.
1920.	8,966	43,944.
1921.	12,365	25,211.
1922.	14,580	27,660.

"INSECT PESTS OF COTTON."

BY

PROF. H. A. BALLOU.

The cotton pests in the West Indies are much the same as at the time of the last Agricultural Conference held in Jamaica.. There has, however, since that time been added to their number one very important pest—namely, the pink boll worm. Amongst those formerly known several have come to be regarded as being of much less importance than they were formerly thought to be. The important points to be noted at this time are, the success which has attended recent attempts to control the cotton stainers in certain islands, and the invasion of these islands by the pink boll worm, with the measures that have been undertaken for its control. The cotton worm, which has occurred with more or less regularity in all the cotton-growing islands, is well known to cotton growers. Its attacks are occasional, sporadic, and not often persistent. The control of this insect by the use of Paris green or London purple is well understood and, given favourable weather conditions, the cotton grower, although put to the expense of material and labour for treatment, does not often see his crop prospects materially reduced as a result of attacks by this insect. In former years, in St. Vincent, the cotton worm rarely occurred in such numbers as to occasion an attack, but within the last few years these attacks have been sometimes rather severe. In the other islands the status of this pest has not changed materially. The leaf blister mite and the black scale, which from time to time occasioned rather severe losses to cotton growers, have for several years past been considered very minor pests. The working of the close season has been quite effective in safe-guarding against serious attacks by these pests. The flower bud maggot which caused losses amounting almost to complete loss of crop in one or two seasons in Antigua has for several years now been quite inconspicuous as a result of a knowledge of its seasonal history and the consequent action of planters in planting their cotton at such a time as to allow the crop to be properly formed before the attacks of this minute fly should seriously affect the production of flowers and bolls. The boll worms which affect cotton also have not been reported as causing serious loss for several years past, nor have cut worms attacked the cotton seedlings in any general way recently. Aphis and Red Spider, likewise, although occurring over limited areas and at irregular intervals have not been reported as serious pests.

Mexican Boll Weevil.

It may not be out of place here to refer to the steady and persistent spread of the Mexican boll weevil in the U.S.A. This insect is not known to occur as a pest of cotton in the West Indies, but it is of interest to cotton growers the world over as being a pest for which no adequate control measures have been devised in the 30 years during which it has been steadily extending its depredations over the cotton belt of the U.S.A. Starting in southern Texas it has steadily spread until now it occurs practically in every part of the cotton belt. The only cotton-growing areas in which this pest is not established are those regions of Arizona and Lower California (in Mexico) where cotton is grown under irrigation. Dusting with Calcium arsenate by means of special machinery promises a degree of control.

The pink boll worm, now occurs in almost every cotton-growing district in the world. The U.S.A. have not been generally invaded, this pest having been recorded in only a few localities in Texas and Louisiana. The progress already reported indicates a probability that the measures adopted may result in the extermination of this pest in those localities. This insect was first reported in the West Indies towards the end of the cotton season in 1920, when it was found to be generally distributed in Montserrat and St. Kitts. Since that time it has been found in Nevis and the Virgin Islands, in Santa Cruz and Porto Rico. During last year, 1923, it made its appearance in Barbados and St. Vincent.

It was expected that the attacks of this insect would have occasioned such serious losses as to make cotton-growing in the British West Indies quite unprofitable, but the experience so far has not borne out this pessimistic forecast. It is too early yet to say what the status of this pest will be in Barbados and St. Vincent, but in Montserrat and St. Kitts it has been found that the methods of control which have been adopted are adequate to allow for a reasonable crop of cotton to be produced in spite of this pest, if the weather conditions are favourable to the growth and development of the crop. The strict enforcement of the provisions of the close season, thorough cleaning up of all fallen bolls and scattered seed cotton in the field, and the careful cleaning up of all ginneries and store-houses and other places where seed cotton and cotton seed have been handled, together with the daily fumigation of all cotton seed coming from the gins during the day, appear to have been very effective in reducing the numbers of this pest. These measures, together with the cultivation of a heavy yielding cotton which gives the bulk of its potential crop in its first bearing, have produced some extraordinary results in the way of heavy yields in the past two or or three years, since the introduction of pink boll worm in the northern islands.

Cotton Stainers have been known as serious pests of cotton since the first establishment of a Sea Island cotton industry in the Lesser Antilles. It is only since 1916 that the exact nature of the injury caused by these insects in the West Indies has been fully understood. In that year it was demonstrated that the cotton stainers were responsible for the attacks of internal boll disease. Cotton bolls affected by internal boll disease produced stained or rotton lint. This staining or rotting was found to be due to the effect of fungi or bacteria, which are able to gain admission to the interior of the boll only when these have been punctured by the stainers or other plant-sucking bugs. This is usually referred to as cotton stainer attack, because these insects are much more numerous than any other bugs ; and in fact when the stainers are present they almost entirely mask the effect of the others.

There is nothing in the external appearance of the boll to indicate that it has been attacked by cotton stainers. Small bolls are often caused to drop as the result of attack, and one fairly serious phase of stainer attack is the loss of a large proportion of the bolls while these are quite small. It may happen, however, that plants bearing large numbers of perfectly healthy looking bolls may be so severely attacked that no clean or unstained cotton can be produced by them.

In dry climates and in dry seasons stainer attack may not be followed by internal boll disease. Boll dropping, deformed bolls, weak lint, and light and infertile seeds are the effects of attack under these conditions.

A very satisfactory degree of control of these insects has resulted from the observance of the close season and the general cleaning up, together with a campaign for the destruction of certain wild food plants which formerly served to provide for the feeding and breeding of cotton stainers during the non-cotton season.

In regard to the caterpillars, Professor Ballou said:—Caterpillars hide during the day time, but so small are they that the entrances they make in the bolls are never seen unless by somebody who has made a study of looking for them. If the bolls are cut open a reddish caterpillar can be found usually inside the seed, because it is generally the seed the caterpillars feed upon. Just a word as to how these insects get about. Towards the end of the cotton season, the devastation of the bolls reaches a very high stage, so that there is a tendency to get on your heavy crops in the first season, but when you get to the end of the cotton season you find that the caterpillars curl themselves in the seed and go to sleep. They might stay there for 12 months or 20 months and we have had an instance where one stayed for 30 months. Egypt, which is one of the great cotton growing places of the world, was invaded by insects by the introduction of bolls of cotton seed. In Brazil certain kinds of seed were taken out there, and as a result the entire cotton fields of Brazil were infested in this way. The same thing happened in Mexico, where they imported cotton and imported the pink boll worm also. In the United States before the great war they had kept a close watch on these insect pests, but in 1916 when Mexico was filled up with the cotton seed, the pink boll work also found its way into the United States. The United States Government authorities had intercepted this pest in the past, but latterly specimens had been allowed to pass inspectors, and in this and in other ways disease went to the United States. The other day when the Mexican revolution was proceeding, the Mexican army wanted to move over into a certain area, but the Agricultural inspectors had influence enough to stop the movement of these Mexican officers. But the great thing to notice is that in spite of the fact that the pink boll worm is fully established, great care has been taken by the planters under the direction of the Agricultural officers, and this has resulted in the very large crop which they produce.

With regard to Montserrat of course this is due to the fact that they have good weather there and they gather their cotton in by the first 2 weeks in March.

The President: One great point to emphasize is that the control has been entirely on a community basis. The control would have been useless if it had not applied to the entire community. When this system was first introduced we were not certain that it would be successful, but, as we have been told, it has been successful. I emphasize this to show you what can be achieved by scientific control over these

pests and the success is not only due to the work of the scientific officers, but also to the community and the planters who took an interest in this matter of control.

Mr. Bovell said that in regard to cotton cultivation a profit of £50 per acre can be obtained. He said this from personal experience but he would not recommend that to the planters as a general rule.

Professor Ballou: In 1903 hundreds of acres of cotton were badly infested in Barbados. There was no Paris green in the island and we tried an experiment of simply putting lime by the handful under the plants, and the result was that a number of the trees were saved.

"RESEARCHES ON COTTON."

BY

PROF. S. C. HARLAND, D.SC.

The price of a low grade type of cotton has remained stationary. There is no great demand for Sea Island cotton, so that the question before West Indian planters now is whe ther they should continue to grow a high grade cotton for which there is no demand, and for which they would have to wait for a long time before they could sell their produce, or whether the planter should substitute a cotton of inferior quality. Now the proposal in regard to cotton is that the West Indies should be divided. Take an island like Nevis with a low rainfall, owing to the irregularity in the rainfull that island cannot produce a high grade cotton. St. Kitts and Montserrat may be placed together in another zone. St. Vincent will always stick to Sea Island cotton for which there is a fair demand. In regard to the other part of the West Indies, Trinidad and possibly Jamaica, would form one part, but certain parts of Jamaica would have to be considered separately in considering what kind of cotton to go in for. With regard to cotton growing we know more about it than any other crop, because so many people have had to do with it. Now the criterion that we want is this. If you start a new cotton industry anywhere you have to consider the requirements of the manufacturer at the other end. There has been new activity in the work in England, and it is now proposed by botanical examination to grade it and get a very fair estimate as to how it will spin, and they have got some sort of technique for cutting the spinning and considering what kind of cotton they are going to grow. I suggest that attention should be first concentrated on the type of cotton very similar to the White Egyptian which produces cotton of a pure white strain, such as exists in Montserrat and St. Vincent. With regard to Sea Island cotton such a cotton should be readily saleable and should have a good demand. My opinion, gathered 10 years ago from cotton breeding, is that this kind of cotton can be grown, but you have to contend with drought resistance, rain resistance and resistance to disease. The proposal therefore is that we should get a cotton of the White Egyptian type. The idea is that we take the existing Sea Island cotton and select from it what length of cotton we want. You will be able to breed for any length you want. This is an absolutely simple matter and just as the Sea Island cotton has been increased in length by selection, so in very short time by this method of selection you will be able to get this new type of cotton, and I suggest that the Georgia Sea Island would be the right type to work by. Now with regard to the future development of cotton in the West Indies,

there are no results in Jamaica by which you can judge what has been really done. If you make a certain examination of a certain number of plants in a plantation, you will say that you cannot grow cotton in this particular place because so much per cent. of the bolls are left; but in trying to find out the best way to develop the cotton industry, you must get a certain percentage of losses and let us find out exactly where we stand. We must discover the leaks and take steps to stop them. In St. Vincent they discovered this, and we were able to control it and deal with the matter. Now if you read of experiments in cotton growing in West Africa, they say that they cannot grow cotton in this or that particular district, and nobody knows the rea on why. With regard to the type of cotton grown in any particular district, a careful examination would have to be made as to the habits that you desire. If you take the ordinary West Indian perennial and cross it with the ordinary African product, you can cross it and get any length you want. I know that Jamaica is not a cotton growing island, and it has been said the other day not to put all your eggs in one basket. I would urge that you give more scientific study to the subject, and if the crop does not succeed you will know the reason why.

Mr. Archibald Spooner: I would say that not very much cotton has been grown in Jamaica within recent years. We have lands in the South of the island, but owing to the uncertain rainfall those lands cannot be made use of by irrigation, and therefore I do not see that there is much likelihood of attempting to grow cotton here on a larger scale than we have been growing, as long as other crops can be raised, such as bananas and canes. With regard to the pests it would be a very difficult matter, over the large areas we have, to eliminate them and to find out the causes that are responsible for those pests. We have the cotton worm just as badly as in other islands of the West Indies. The boll worm had done a great deal of damage before we knew anything about its cause. With regard to other varieties of cotton some attempt has been made to do this. We have tried a sort of hybrid between the Peruvian cotton and Sea Island cotton and we found that no bolls were produced. It did very well at the first planting but afterwards it gave way to attack by insects.

The President: Owing to the vigorous efforts that we made in two or three of the smaller islands where cotton could be grown, I would not say in equal quantities, very good results has been obtained, so that now we have overgrown, and we are finding at the present time that the world has no particular demand for it. There is a real danger of a cotton famine if we switch off our minds from the Sea Island cotton. There will be a demand for more and more cotton, and if there is any part of the West Indies where cotton can be produced it will be a very good industry. Dr. Harland has said that there is no particular district where we are certain that cotton can grow, but by studying the various localities it is possible to produce a cotton which can be grown in most districts. There are one or two serious troubles which confront us and one of these is the class of insect that gets into the interior of the bolls. But I am not giving up hope that in time to come we will be able to control this, and in the investigation which will be carried out at the Imperial College in Trinidad, if not anywhere else, the different types of cotton will be looked into. We want to go a little further and look into new regions, and see if these new regions cannot be made to produce good cotton, and I hope that in the next ten years we will see whether we will not be able to establish another type of cotton. It is interesting to know that the efforts which we

have made has changed the life of two or three West Indian islands. Montserrat is now a cotton growing island almost altogether, and so is St. Vincent, and it is remarkable to see how the entire life of a community has been changed in this respect. We will have to look for a Super Egyptian type and possibly Jamaica might come into line and benefit by it.

"MOSAIC DISEASE OF SUGAR-CANE."

BY

C. G. Hansford, M.A (Cantab.)

The disease was first noticed in Java about 1890, but was not then recognized as a disease of an infectious nature, as the investigators there were all unable to reproduce the disease artificially by inoculation. It was regarded as an undesirable type of variation of the cane, a kind of degeneration of the various varieties which were found to be worst attacked. Since then it has been discovered in most cane-producing countries of the world, probably having been spread largely from Java on the seedling canes exported from that island to the experiment stations and cane nurseries in the other cane-growing countires. In the West Indies it became serious in Porto Rico in 1917-21, in Jamaica since 1920, and in Cuba since 1921.

The symptoms of the disease are well known to almost every sugar planter in the West Indies, so that it is unnecessary to dwell on them here. The disease belongs to a large group of plant diseases which is coming into great prominence at the present time. These diseases affect a great variety of plants in a very similar manner, and are termed Mosaic Diseases, by reason of the peculiar effect which many of them have on the leaves of attacked plants. Between the various Mosaic Diseases there are distinct differences known, especially in their methods of spread, and transmission from plant to plant. Thus, for instance, in the case of the Mosaic Disease of Tobacco, the disease can be transmitted from a diseased to a neighbouring healthy plant by merely the contact of the leaves of the two plants. In the case of the Mosaic Disease of the Sugar cane, on the other hand, infection cannot be brought about at all by this method.

The actual causes of the Mosaic Diseases have never been discovered though many investigators have worked on this problem. Although this is the case, many facts are known about the diseases and their behaviour in the field. Each disease has a definite range of host plants, and within this range is transmissible from one host to another. From time to time various workers have claimed to have discovered the cause of the diseases, which has been stated by them to be an enzyme, an ultramicroscopic organism, or a protozoan. It is now recognised that we have no evidence to support any of these views, and indeed, the most recent suggestion, chiefly due to the work of Nelson in the U.S., that the diseases are due to protozoa living in the phloem of the diseased plants, must be discounted. It now appears that the bodies which Nelson figured as Protozoa are present not only in the phloem of diseased plants, but in that of healthy plants as well, to the same extent, and are probably abnormal nuclei, or some other complex protoplasmic bodies in the cells, staining in a manner similar to nuclei. Other cases are known of plants being inhabited by parasitic protozoa, but these organisms have never been proved to have any connection with

diseases of the Mosaic type, and indeed, are found in plants which otherwise appear perfectly healthy. A fact which cytological workers on the disease seem to discount to a great extent, is the behaviour of the expressed cell sap from plants suffering from Mosaic Diseases. This sap can be passed through filters which retain all the ordinary disease-producing organisms, and still retain its infective properties unimpaired. At the same time its activity is reduced, according to Brandes, by exposure to the air. This indicates that the infective particles must be much smaller in size than any of the common pathogenic organisms of plant diseases. Although the cause of the disease remains unknown for the present, its effects on the tissues of the plant have been carefully studied. They are most marked in the cells of the plant which contains the green chloroplasts. These bodies represent the actual food factories of the plant, and undergo a process of degeneration in plants attacked by Mosaic Disease, resulting in their being unable to function in a normal way. This process of degeneration of the chloroplasts of the green parts of the plant is manifest to the naked eye in the symptoms observed in diseased plants, namely, the general pale green appearance of the plants, and the light green Mosaic effect of the disease on the leaves which gives the name to this group of diseases. The light green part of the leaf which are apparent to the naked eye are simply those parts in which the chloroplasts have degenerated. Badly diseased plants in the fields are often characterised by an appearance of mal-nutrition, and are sometimes dwarfed; these symptoms being due to the inability of the chloroplasts to function properly in forming food for the plant. These extreme symptoms are often observed in varieties very susceptible to the disease, such as B. 208. These symptoms are more pronounced on corn (Maize) plants attacked by the disease, which is also able to attack certain other closely related plants of the grass family, *Gramineae*. Often the effects of the disease on corn as noticed in Jamaica are to render the plants wholly or partially sterile and some are much dwarfed. The same is true to a less extent with Guinea Corn (*Sorghum* spp.)

Source of Infection.

This Mosaic Disease of Sugar-cane is not limited to this single plant, but, as indicated above, is able to attack a number of other related plants, among which are *Zea mays, Holcus sorghum, Pennisetum glaucum, Miscanthus sinensis, Saccharum spp., Paspalum boscianum, Syntherisma sanguinalis, Chaetochloa lutescens, Chaetochloa magna, Echinochloa crusgalli, Panicum dicotomiflorum, and Brachiaria platiphylla.* It is interesting to note that among the grasses tested by Brandes in Washington was Para grass, which gave negative results on inoculation. The same worker proved that the mosaic disease on these various grasses was transmissible from one to the other and also to the sugar-cane. Consequently, possible sources of infection to a crop of sugar-cane must be looked for, not only in neighbouring crops of sugar-cane but also among the various grasses which are weeds of sugar-cane fields. The list of grasses which are susceptible to the disease, given above, is probably by no means complete. In consequence of these considerations it is more than ever imperative that sugar-cane estates should be kept clean from weeds as far as is humanly possible, in order to eliminate this source of infection of the crop by mosaic disease.

The actual method of transmission of the disease from a diseased to a healthy plant is still the subject of some controversy. It was noticed

repeatedly by the earlier workers on this disease that this transmission of the disease varied greatly in intensity from time to time. Many experiments have been carried out on interplanting rows of diseased plants with healthy canes of the varieties susceptible to the disease, and the results have always shown that the disease is transmitted from the diseased to the healthy plants. We have no evidence that this transmission of the disease takes place otherwise than through the air. A good deal of evidence has been accumulated that the disease does not persist in the trash from the infected plants, nor in the soil which has grown a heavily diseased crop. From practical experience it has been found that when the diseased plant is pulled up and allowed to wither, there is very little, if any, risk of infection being transmitted to neighbouring healthy plants.

Up to the present the only methods of artificial inoculation of the disease which have given successful results are, (1) the injection of the juice from infected plants into the growing point of the stem of healthy plants, and (2) by making use of certain insect carriers of the disease. Better results have been obtained by Brandes, using the first of these methods, in those experiments in which the juice was not exposed to the air at all. It is evident that such a method as this cannot occur in nature. Brandes was the first to prove that the Corn Aphis (*A. Maydis*) is capable of carrying the disease, and his results have since been confirmed by Bruner in Cuba and by Willbrink in Java. These workers have proved that this insect can transmit the disease from any diseased plant of the species mentioned above to any other one. Although several other insects have been suspected of acting as carriers of mosaic disease, no positive proof of their capacity to act as such has yet been advanced. This method of the transmission of the disease from diseased to healthy plants is the only one which has so far been proved to occur under field conditions. The disease is not carried by the wind, neither does it remain in the trash from the diseased crop, nor does it exist from season to season in the soil. Infection of the healthy plant can only been brought about through the young tissues of the growing point of the stem, a fact which is supported by observations of the behaviour of the disease in the field.

From actual observation in the field it has been conclusively proved that the disease is spread in two ways, first by the planting of diseased tops in fields and secondly by the transmission of the disease from diseased to healthy plants. In the past, the cane planters of the West Indies have been notoriously careless in this matter of planting diseased tops, and in the course of time, the wholesale spread of the disease has resulted. Secondary infection, that is the infection of a healthy shoot arising from a healthy top or ratoon root, may take place at any time after the first appearance of the shoot above the ground. It has often been noticed, however, that the intensity of secondary infection is greatest when such shoots are young and are from one to two feet high. The transmission of the disease to these healthy shoots is often quite limited in the later stages of the growth of the shoots, when the canes are over five feet in height. If the infection occurs early in the life of the cane only the very oldest leaves will be found to be free from the disease, whereas if this infection occurs later, several of the older leaves and joints will remain healthy. In all cases, however, the tops of such canes will show symptoms of the disease, and if planted will give rise to diseased plants.

It has been found from practical experience in Jamaica that wherever corn is planted, either among or in the near vicinity of sugar cane, that

the amount of mosaic on the latter is much increased. The corn is not only attacked itself but also seems to act as a factor favouring the rapid increase of the insect carriers of the disease.

The losses from mosaic disease have been determined by various workers in most cane-producing countries to be very considerable, amounting in some cases to a loss of from 30-50% of the entire crop of some very susceptible varieties. The various varieties of cane at present cultivated can be grouped in four large classes, according to the effect of mosaic disease on them. The first of these groups contain the susceptible varieties, which include among their number many of the better classes of seedling canes. One of the chief effects of mosaic disease on cane plantations in the West Indies has been to cause them to discard their susceptible varieties in favour of others more resistant to the disease. The second class of varieties of cane includes those which can be said to tolerate the disease, or in other words, those varieties which although quite susceptible to the disease do not suffer so severely when actually attacked by it. Many of the more recently developed Java seedlings belong to this class, and some of them can be cultivated with profit even though 100% diseased, as is now being done in the Argentine. The third class comprises those varieties which are resistant to the disease, though when attacked they may sometimes suffer heavily. It has been noticed that the symptoms of the disease on varieties belonging to the last two classes are often very difficult to recognise in the field. This is especially the case with certain of the newer Java seedling canes such as GZ 100 P.O.J., a variety which was at one time cultivated in the Experiment Station at Hope Gardens, Jamaica. It was found that the symptoms of the disease on this variety were so difficult to recognise, that it was impossible to eradicate the disease from this cane nursery until this variety had been discarded altogether.

The fourth class of varieties comprises those which are immune to the disease. These canes are all of the thin type, which has certain objections from the factory point of view, and is looked upon with disfavour by many estate owners. These varieties of cane are proving very valuable to those estates where the mosaic disease has been allowed to become serious in extent.

The measure recommended for the control of this disease depend on these facts; that the disease is always transmitted in tops cut from infected plants; that infection is transmitted through the air from diseased to healthy plants; and that the infection is not retained by the soil.

Generally speaking, there are two methods open for fighting mosaic disease. The first is to replace the older susceptible varieties of cane by the more resistant or more tolerant, or immune varieties. The second is to eliminate the disease on the present standard varieties of cane. The only immune variety of cane which is available in Jamaica is the Uba, a variety which is not popular with the factories.

In Java, the disease is said to be controlled by the selection of sound tops and by the use of resistant varieties. Owing to the precautions necessary there against Sereh Disease, the only canes grown for the manufacture of sugar there are plant canes, and the tops for planting are supplied from special nurseries in the hills. These arrangements make it comparatively easy to keep a systematic supervision on the tops used for planting, and to make certain that they are not infected with Mosaic disease. Kobus attempted to eliminate the disease entirely from the tolerant varieties GZ. 36 P.O.J. and 33a by selecting only sound seed for propagation, but was unable to do so, owing to the symptoms being too slight on these varieties to be noticed. This is true of several

of the more recent Java seedlings, and as the effects of the disease upon them are so slight, it seems to be unnecessary in practice to attempt to eliminate the disease from them completely.

The disease was probably introduced into the Argentine on these same varieties of cane, and spread on to the varieties cultivated there previously. The result has been that, owing to the greater powers of resistance and tolerance possessed by these Java seedlings they have replaced the older varieties there almost completely, with the result that the estates in that country no longer worry much about the disease. Earle thinks that these varieties are hybrids between a thick variety of cane and one of the thin Japanese or Indian canes. They appear to give good tonnage and to ratoon well. The great risk in importing these canes into the West Indies is that we are liable to import some of the other cane diseases on them, which are not found here as yet. It seems preferable to develop our own new varieties along these lines, that is, by crossing such canes as the Uba with other good estate canes.

The great disadvantage in importing these more recently developed Java seedlings into Jamaica, lies in the experience that these varieties will replace the present standard varieties altogether in the course of time, with a class of cane which is 100% infected with Mosaic Disease. The result is that any new high grade seedling cane, which it may be thought desirable to import subsequently, will be killed out by these other varieties more resistant to Mosaic.

It seems preferable to us here to attempt to eradicate the disease as far as possible from the varieties at present cultivated here, leaving the way open for the importation of new high grade seedling varieties, which may be preferable from the factory point of view.

The disease was discovered in Jamaica in January, 1920, by Dr. Lyon of the Hawaii Experiment Station. Soon after this discovery a careful survey of the island for the disease was made by the officers of the Department of Agriculture. It was found to be scattered all over the island in most of the cane-growing areas. In some districts only an occasional affected plant was seen, while in others the disease was of considerable proportions. In June last year, a second inspection of the island was made and it was found that the disease had increased greatly in the interval, especially in some districts. On those estates, whose management had followed the advice given by the Department three years ago, the disease had been kept down to a minimum. Other estates in Jamaica have now almost 100% of infected plants and the disease is causing them great loss in the field and in the factory. On the whole, the sugar-planters of Jamaica have now learned by bitter experience the effects of the disease on their crops, and are now determined to make a concerted effort to eradicate it from their fields. From the stand-point of mosaic disease the estates in Jamaica fall into three classes. The first comprises those estates where there is a general small proportion of the disease either in few fields or generally distributed over the estate. On these estates, it is recommended that the disease be eliminated by digging out all diseased plants found in the fields. This process of roguing must be carried out systematically and carefully, in such a manner that every field of the estate is carefully searched for diseased plants at least once every ten days. This process carried out in such a manner will eventually rid the estate of the disease entirely. In roguing newly planted fields it is important that the first inspection be made as early as it is possible to distinguish between healthy and diseased plants. It has been found from field experience that it is not necessary to destroy the plants dug out, but it is sufficient to merely

leave them in the sun to dry. In the case of ratoon field it is often found that a root may only be partially diseased, that is, some of the shoots arising from the root may show symptoms of the disease while others do not. In this case, it has been found that it is sufficient to pull out the infected canes from such a root, instead of digging out the whole root; in order to minimise the need for supplying gaps left by roguing plant fields, many planters of experience plant their fields very close in the row. After the infection on an estate has been reduced to a minimum by this process of roguing their fields, it is still necessary to continue the process as an insurance against recurrence of the disease in quantity.

The second class of estates includes those, where in addition to a small general infection, there are a limited number of fields where the disease is more serious in extent. On these estates the badly diseased fields should be allowed to mature and replanted after the crop is out. It is advisable to plough the land as soon as the diseased crop has been cut, and allow it to lie for a month or two before replanting it with healthy tops. During this interval all traces of the preceding crop, such as "bank canes" can be totally eliminated as fast as they appear. The other fields of these estates where the infection is low should be rogued in the same manner as described above.

On certain estates in Jamaica at the moment the mosaic disease problem is more complicated. They have a heavy general infection over a large portion of the estate, and cannot rogue out the diseased plants from this. From the factory point of view it may be said that it will not pay to rogue out the diseased plants from a field which shows more than 15% of infection. These estates where the infection is so serious are forced to fight the disease in an entirely different way. Under the present circumstances in Jamaica they are obliged to fall back on the Uba cane as a means for their salvation. The estates should be divided into large sections, and these sections planted in Uba cane. From these sections all other cane should be eradicated completely and in this way the sections are cleaned of mosaic disease. Afterwards the Uba cane can be replaced by clean tops from a special nursery of other varieties. These sections should be arranged in such a manner that those planted with healthy tops replacing the Uba are separated by a broad belt of the Uba from the other parts of the estate which have not been cleaned of mosaic, and in this way to reduce the risk of the infection being transmitted from the latter to the former.

The objection to importing the "Tolerant" Java seedlings into Jamaica is that it is difficult to obtain clean seed and almost, if not quite, impossible to eliminate the disease from them in the field by roguing, as the symptoms of the disease on these varieties are very obscure. Therefore, under estate conditons they would remain a persistent source of infection to other more susceptible varieties grown near them, with the result that the latter would be eventually killed out. This has actually occurred in Argentine. It seems preferable for us in Jamaica to raise our own resistant varieties rather than import these from Java, and in any case the present position does not warrant the total discarding of the present standard varieties of cane cultivated here.

In dealing with the question of the control of Mosaic Disease in Jamaica, it would appear that in the past sufficient attention has not been given to the extent of the infection of the disease on plants other than sugar cane. It is a prevailing practice among the smaller cane farmers to interplant their canes with maize. This is a practice which under the present circumstances is extremely dangerous, as the effect of the corn seems to be to enormously increase the intensity of

secondary infection, that is, the intensity of the aerial transmission of the disease from diseased to healthy plants. In consequence of these considerations this practice has now been prohibited in Jamaica, and the growing of corn in the cane areas of the island is to be prevented as far as is possible. (Applause.)

The Conference adjourned for lunch.

WEDNESDAY AFTERNOON.

Sir Francis Watts: We can resume our discussion where we left off on the Mosaic disease of canes. Mr. Hansford has read an interesting paper on this subject, and perhaps we might adjourn the discussion until a later stage. I don't know if any one wants to say anything on it at this stage. Perhaps, however, Mr. Bovell might tell us something about the disease in Barbados.

Mr. Bovell: I have very little to say with regard to this disease in respect to Barbados as we do not have it there. But I might mention in connection with the disease that a man who was at one time in the Department of Agriculture at Barbados, and who is now in charge of over 10,000 acres of cane in Porto Rico, wrote some time ago telling me that when he first took charge of the estate the amount of Mosaic infection was about 80 per cent., but that by vigorously roguing, and planting only from seed pieces taken from canes free from disease, he had now reduced the incidence of the attack of the disease to about one-thirtieth of one per cent. (Hear, hear.) He tells me that they regularly examine the canes at the experimental station there for the Mosaic disease, and when they find any traces of it, it is promptly dealt with. By this means they have been able to check the disease. You must also remember that some grasses carry the disease. In Barbados we have one or two grasses that do this, and it is easy for the disease to be conveyed from the grasses to the sugar cane. So it is necessary to take precautions all the time. This is only what I have to say, but I want to emphasise the point that it is very necessary to plant cane free of disease.

Sir Francis Watts: Prof. Ashby, have you any information with regard to Mosaic in the Leeward Islands. Do you remember the circumstances?

Prof. Ashby: Haven't you a paper by Mr. Collens on the subject?

Sir Francis Watts: No, he has not sent in one. I don't know whether you can just tell us something of the principal facts.

Prof. Ashby: I will give what information I have, but I thought he would have given the details in a paper. Mosaic disease has been absent from the Leewards Islands until the beginning of last year, when we had it reported from Antigua, St. Kitts and Nevis. It apparently had been introduced into St. Kitts from the neighbouring American Virgin Islands on the seedling cane 124. This probably took place about 1919 in some canes received at St. Kitts from St. Croix, although it was believed at the time St. Croix was free of the disease. They were propagated on some estates and in the course of three or four years, quite a considerable area was infected, but it was only last year that the disease was discovered in St. Kitts. The course of the disease was closely investigated and it was found that the disease was confined to the Santa

Croix seedling and was not on any other cane on the property. It had apparently got on one or two other estates in addition, but right up to the present time, four years after it was introduced into St. Kitts, it has only been found on one single seedling, and not on any other single variety of cane—a very remarkable thing. It shows that the disease in St. Kitts for some reason, spreads very slowly. It must spread exceedingly slowly, as it is only being propagated by diseased cuttings from one variety, and means are now being taken which it is hoped will succeed in completely eradicating it. They are now talking of eradicating this particular seedling, and it looks very much as if they will succeed in eradicating it. In Antigua the position is not quite so favourable, and in some cases in Nevis it has escaped to a number of other varieties, and they will have great difficulty in keeping it under there. That is the position in these islands, so far as I know it to-day. With regard to the question of the relation between grass and Mosaic, a good deal of work has been done during the last couple of years, and a good many points have been cleared up in different parts. As regards the grasses we have discovered two kinds of grass which actually get the Mosaic itself,—which are hosts to the disease. And there are also grasses which although not hosts, are carriers of the disease. As a matter of fact, there are grasses which get the disease and are hosts, and carriers. This has been definitely proved in the case of one insect, the *Aphis maydis*, known in Java as the *Aphis adusta*. It is the same thing. This has been definitely proved in a number of well proved experiments more particularly in the United States, Porto Rico, Hawaii and especially in Java, where it is shown that the *Aphis maydis* is the same as the kind found in Java. There is, however, a difference in attacking the cane. The *Aphis maydis* gets into the middle of the spindles, into the middle of the young plant—brings itself in contact with the very young actively growing plant tissue, whereas the other Aphis is only found in the external part of the leaves and is not to be detected in the young tissue. With regard to grasses, more will have to be done with regard to determining what grasses in a cane cultivation are the actual hosts for this particular Aphis. It does not like cane and only goes in the cane when we weed out the particular grasses that are its hosts. The Aphis lives on particular grasses, and soon as you weed these up you deprive it of its particular hosts, and it jumps on the cane, wanders from one plant to another, and so you get a good deal of cane infection arising in that way. I think probably that accounts for the fact that the disease is spread far more rapidly in wet weather and in wet localities than in dry localities and dry weather. In wet weather you have a more active weed growth than in dry weather and every time you weed you deprive the Aphis of its natural host, it gets in the cane. When the weeds come up, they act as a check on this particular disease of the cane. So what we really want to know is a good deal more about the actual weed grasses which occur in our cane cultivation, and also the presence of this Aphis in them. No actual method of control based upon a knowledge of these insect pests, is in practice as yet as far as I know. A more thorough knowledge of its relation to these grasses and its relation to the cane will probably enable still more efficient methods to be worked out than we have at present for controlling it. Recently I saw in letters sent from a Central in Porto Rico, that they have claimed to have had a large degree of success by the roguing method, even where they started with 90 per cent. infection—that by carrying out rigourous roguing to a considerable extent, they had kept the disease down to less than one per cent. So that even where you have high infection, by a thorough system of

roguing—this, of course, will involve expense - you likely can keep the disease under control without sacrificing your desirable canes, which have been found susceptible to the disease. You may, of course, introduce a highly resistant cane of inferior quality to get rid of the disease if you have the patience to do this. The expense to save the desirable cane might really represent a considerable saving, because you have to reckon against both the losses you incur, in sacrificing your desirable cane, and keeping on the inferior canes until you get your cultivation free for the desirable cane again. With regard to the Uba cane I do not know that it is immune to the disease. It shows no symptoms of the disease, but it does not follow that the Uba cane is not a carrier of the disease. We know, however, that the Java cane G.Z. 100 P.O.J. may carry the disease although in an exceedingly obscure form, and I believe we have reason to think that the Uba cane carries the disease, only it is not visible on it. If you are to propagate the Uba canes here you must be very careful about it, for as I told you while they may not have the disease themselves they may be capable of transmitting it. We have to gain all the knowledge we can about this disease so as to learn the best method of combating it. It is possible where the disease is not wide-spread to bring about a gradually improved condition of affairs, by adopting a strict method of seed selection. (Applause.)

Mr. Murray: With regard to Mosaic disease in Jamaica, I am rather surprised to hear that in Porto Rico they use roguing successfully where the disease extends to an appreciable extent—from 80 to 90 per cent. Our experiments here show that with anything over 10 per cent. it is almost impossible to eradicate the disease, and the only alternative is replanting. You will rogue the 10 per cent. of the infected area, and then for some unexplained reason you will find the disease straying up at a different point, and the percentage goes up. It is considered that the best way to treat the disease in Jamaica where you have an infection of 10 per cent., or more is to replant the field the following year. Our experience is that when once Mosaic takes possession of the cane nothing can save it. So far as the source of infection goes, there is nothing to account for it, and it must be due to insect pests living in the fields. We are in the position in Jamaica where we have to seek a resistant cane to Mosaic disease. The problem is the most serious at the present time facing the sugar planter of the island, and an effective method of control of the disease would help our sugar planters more than anything else at the present time.

Sir Francis Watts: Prof. Ashby, will give us your paper on some aspects of sugar cane diseases?

Prof. Ashby: I have a short paper here dealing with three cane diseases not yet present with us in the British West Indies. Nevertheless, they are three major diseases and it is necessary that our planters should know something about them. One of the worst of the latter is actually present in the West Indies, therefore, I think I am justified in saying something about these diseases.

"THREE SERIOUS CANE DISEASES NOT YET REPORTED FROM THE BRITISH WEST INDIES"

BY

PROF. S. F. ASHBY, B.SC.

I propose to draw your attention to three injurious parasitic infectious diseases which are now spreading in cane growing regions although so

far only one of them has been detected in the West Indies. All three are propagated by means of sets and secondary infections of the aerial parts, but are very distinct in their causation one being due to a bacterium, another to a fungus, and the third apparently to a unicellular animal. These diseases are Gum Disease, Fiji or Leaf-gall Disease, and Stripe Disease.

Gumming, Gum Disease or Cobb's Disease.

The disease calls for particular attention because it is already present in the West Indies, having been observed in Porto Rico in 1920. Since then it has been found over a considerable area in that island. You may recall that Porto Rico was the first place in which Mosaic was found in the West Indies, and that within a few years it was discovered in several other parts of that region. Gum disease has been known for a long time. It was present in a severe form in Northern Brazil during the 60's of last century, dates back to the 80's in Australia and Mauritius, and later in Fiji and Java. It seems reasonable to suspect it as being present in Cuba, San Domingo and the American Virgin Islands.

Symptoms—These symptoms have been regarded as characteristic of Gumming.

1. The chlorotic stripes on the leaves.
2. The oozing of a yellowish gum from the severed ends of the fibres when a stalk is chopped across.
3. The red colouring of the fibres in the stalks, especially in the nodes.

To these may be added in the case of susceptible varieties:

4. Failure of the sets to sprout.
5. Backward or stunted growth often resulting in dead tops, and gum-filled cavities in the younger internodes.
6. Shooting of the eyes with production of chlorotic, distorted and short-lived shoots.

In Porto Rico according to Matz, the fibres of cut cane may ooze yellow gum copiously without showing a red colour in any part of the stalk.

The same year that gumming was detected in Porto Rico, Wilbrink published a detailed account of a disease in Java. It has all the symptoms of Gumming except the actual presence of gum, so that there is no ooze from the cut ends of the fibres, and the cavities in the younger inter nodes are not filled with gum but with air.

About the same time a new disease was spreading in Australia and Fiji, to which the name Leaf-scald has been given. No detailed account of it has yet been published, but, as it is apparently due to a bacterium, causes stripes on the leaves and is transmitted by the cutlass and by aerial agencies, it may prove to be identical with the Java disease.

Cause of Gumming—It is caused by a yellow motile rod-shaped bacterium *Bacterium vascularum* (Cobb) Greig Smith, which clogs up the water conducting vessels in the fibres with its gum, and floods out into the ground tissue of the younger internodes forming brown gum filled cavities, and at times oozes out of the inner faces of the young leafstalks sticking them together. The red colouring of the fibres is due to a reaction of the affected tissues and not to a red product of the parasite. In the Java disease the causative bacterium is very similar in its cultural characters but, as stated already, does not form gum.

Injury—Infected sets of susceptible varieties often fail to germinate, and rot away or give rise to feeble shoots which die down after a few

weeks' growth. In good weather they may grow on but are frequently smothered out by adjacent healthy stools. A number, however, survive and are reaped with the healthy cane. The effect is most serious on the ratoons, as these may fail to grow, leaving gaps difficult to supply and curtailing the ratooning period. Heavily infected fields yield low tonnage with low sugar content and the gummed juice makes serious trouble in the factory so that high returns of sugar are impossible.

Resistance and susceptibility—Infection experiments in Porto Rico, where the gumming form of the disease is alone known, indicate that Otaheite or Bourbon is the most susceptible kind but the Transparent canes are also quite susceptible.

Yellow Caledonia, Paoaole, D 109, B 109, BH 10 (12) and Uba were found resistant and one or more of them may prove to be immune.

D 109 is now being extensively planted in the most severely affected districts. In Australia the resistant but inferior Malabar or Creole cane has to be planted in place of superior but susceptible kinds.

Transmission—An important means of spreading both forms of the disease is by way of the cutlass. It has been proved experimentally in Java and Porto Rico and is well-known in Australia and Fiji. The cutlass infected at reaping time when diseased cane is cut transmits the infection to healthy stools so that the ratoons tend to become within each crop more and more infected. In the same way the cutlass transmits the infection to healthy sets and so spreads the disease in the plant cane. In Australia and Fiji the disease is also transmitted in the field by some aerial agency—probably insects, from diseased to healthy plants. In wet seasons or on low-lying badly drained land this secondary spread may be be very serious. The disease may also exist latent in the cane without showing visible symptoms but such apparently healthy canes if cut into sets will give rise to visibly diseased stalks. These two latter characters of the Gumming make it very difficult to control and it may be carried unknowingly in cuttings from one plantation to another from one country to another: actually from Fiji to Australia, and originally, in all probability, from Mauritius to Australia.

Definite experiments in Java and Porto Rico indicate that neither the Java form nor Gumming is retained in nor spread through the soil, so that healthy supplies can replace dead or diseased stools without risk of infection from the soil.

The only way to prevent spread in the ratoons by the cutlass is obviously to prevent the cutting of diseased stools. This can be done by taking advantage of the leaf symptoms. In young cane the pale, often white, stripes which show on the leaves as they unfold from the spindle or long and narrow and often streaked and spotted with red: they die and dry up, much sooner than the normally green parts of the leaf. They often resemble the long pale stripes natural to some canes such as Paoaole, but become obscure in the sheaths. The red streaking and spotting of the stripes is also a distinction, and so is their early death.

In mature cane the stripes on the leaves are usually dead and grey, with red streaks and spots near the middle of the blade and away from the edges. They are characteristic and easily detected after a little experience. The best way to avoid the reaping of diseased cane is to send experienced men ahead of the cutters to locate and tie up the affected stools so that they can be left, and to dig out and destroy them after the healthy cane is cut. This procedure serves the double purpose of eliminating the diseased cane and preventing spread by the knife. It also prevents the cutting of tops for planting from diseased stalks. Experiments in Java have shown that infection of tops by the knife can

be prevented by dipping the cutlass into a germicide after each cut; 5 per cent. Lysol solution was used with success; it was also shown that treatment of tops after cutting with germicides or Bordeaux mixture is useless because the bacteria are drawn into the ends of the fibres as the infected knife severs the cane and cannot be reached by subsequent disinfection. As the elimination of diseased mature cane can rarely be perfectly done, and as the disease like mosaic can be transmitted in the field by aerial means, in Australia, Fiji and probably in Java, it is desirable and in fact necessary, where there is evidence of such transmission, to inspect the young ratoon and young plant cane after it is a few weeks old, and rogue out all stools showing the characteristic leaf stripes. When a plantation is already heavily infected by Gumming the only effective remedy is to replace the susceptible variety by a resistant kind, several of which fortunately are grown in the West Indies. In Fiji and now also in Australia the plant pathologists of the Colonial Sugar Refining Company have so much respect for Gumming that seed cane is not cut from a field in which a single affected stool has been found, nor even from fields within a quarter of a mile of an infected field.

The Fiji or Leal Gall Disease.

This peculiar and very destructive parasitic and infectious disease is at present confined to the West and South Pacific Region. Observed for the first time in Fiji about 1905, it threatened the industry there for a number of years before it was got under control about 1912. It has been present in Australia for many years and about 1916 was introduced into the Philippines where it has recently spread considerably. Its native home is New Guinea whence it was carried to Australia and Fiji in cuttings of native varieties, one of which—Badila—has found its way into Experiment Stations in the West Indies.

Symptoms—The characteristic symptom—unique among cane diseases—is the presence of swollen ridges or galls from a fraction of an inch to 2 inches or more in length along the veins on the under sides of the leaves. When a young actively growing stalk becomes infected these galls show on the otherwise normal leaves as they unfold from the spindle. Sooner or later, depending on the susceptibility of the variety, the stalk looses the power to develop normally formed leaves. They become short and stunted, growth ceases, and the top dries up or rots. The leaves or shoots arising from infected cuttings or diseased ratoon stools are narrow, dark green, and erect and show the galls from the start. If the variety is susceptible the stalks are dwarfed, the eyes sprout and produce stunted shoots and leaves, and the plant has a characteristic bunchy appearance and a short life. Some varieties may keep alive but develop no canes and resemble tufts of grass. Resistant varieties may make fair canes but the top dries off prematurely. Stools once infected have never been known to recover.

Cause.—The earlier workers on the disease noted that the swelling on the veins were due to abnormal growth of the bast portion of the fibres, the cells of which contained foreign bodies believed to be a parasitic organism. Recently, McWhorter in the Philippines has shown that these intra-cellular bodies are amoebae,—naked specks of protoplasm capable of creeping movement and classed among the unicellular animals. He has named it *Phytamoeba sacchari*, but has not yet obtained pure cultures and reproduced the disease by inoculation.

Transmission—Cuttings from diseased canes always transmit the disease but it is apparently not conveyed to healthy cuttings by the

cutlass. It was at first believed to be transmitted by the soil but this view has been given up in favour of air-borne transmission by some unknown agent—an insect probably.

Susceptibility—No variety has been found to be immune, and few are resistant. The favourite Hawaii canes, Lahaina, D 1135 and D 109, are all quite susceptible. Badila is the least susceptible and is still the most planted cane in Fiji. In the Philippines some of the native canes have proved more resistant than the imported Hawaii and Java seedlings.

Control—In Fiji the disease has been got under complete control by the use of resistant varieties, rigid seed-piece selection, rotating cane with beans, and taking only one ratoon crop. Advantage was taken of the observation that the disease spreads much less on poor, light soils that on heavy or rich soils. Seed was therefore cut from canes on poor land, and trained men were sent ahead of the reapers to locate and tie up all stools showing any trace of disease. The diseased canes were cut and ground separately and the roots dug up and destroyed. This procedure is maintained even when disease has been reduced to the vanishing point; experience has shown that, if relaxed for a year or two the disease rapidly gains headway.

Leaf Stripe or Sclerospora Disease.

The disease has been present for many years in Australia and Fiji, having been introduced most probably in native varieties form New Guinea. It was taken to Formosa in cuttings from Queensland about 1909 and was brought from Formosa to the Phillipines in 1920. It has not been found elsewhere, hitherto.

Symptoms—The only available description of the symptoms is that given by Miyake in Formosa in 1912. The leaf markings are much like those in Gum Disease. There are similar pale or white stripes with red streaks which, however, spread over the whole leaf which dries up and shreds at the tip in a characteristic way. If the under sides of affected leaves are examined in the early morning a mealy or fluffy layer can be found covering the pale stripes. In some varieties the internodes are much lengthened so that the canes are 2—3 feet taller than healthy stalks, while in others the internodes are abnormally thick. Young cane when infected develops a fan-shaped top due to sprouting of the eyes.

Cause—The disease is due to a fungus—a downy mildew named by Miyake *Sclerospora sacchari*. The leaves are infected by the germinating spores, which are produced only during the night and in great abundance, forming the mealy layer on the under surface of the white stripes. The fungus grows into the stem, from the leaves and infects the eyes.

Transmission—The disease is carried in cuttings from diseased canes and infects the young shoots, the leaves of which develop the pale stripes and then the spores, which are carried by air currents to the leaves of adjacent healthy plants, causing infection. High humidity is necessary for the production and germination of the spores, which cannot resist desiccation. The infection is spread therefore during heavy dews and rainy weather. The tonnage of susceptible varieties, which include a number of Java seedlings, may be cut in half, and the sucrose and purity of the juice seriously reduced. Hard canes like Yellow Caledonia are resistant and give normal returns.

Control—The disease may cause serious loss in young cane, spreading rapidly in favourable weather and necessitating replanting. It is very doubtful if resting spores are produced which infect the soil. Control can be effected by seed selection and the spread in young cane checked

by roguing out the young plants which show the pale leaf stripes before the spores are produced. As the infection is readily transmitted to maize from cane by means of the spores, and back again to cane it is inadvisable to plant corn adjacent to cane in localities where leaf stripe is prevalent.

The introduction of the disease into the Philippines from Formosa is instructive. A large batch of selected cuttings was sent from the Experiment Station and planted out near Manila. The plant cane was carefully inspected by plant pathologists but showed no signs of leaf stripe and was therefore regarded as free from disease. Subsequently, the first ratoons were reported diseased and on inspection infection was found to be widespread in them, a striking example of latent infection and an indication that after ten years the disease had not been completely eradicated from the Experiment Station in Formosa.

Experience has abundantly shown that the last place a foreign variety should be brought into is an Experiment Station. Such introductions are frequently resistant to one or more diseases present in the country from which they come and probably unknown where they are introduced. Being resistant, they may show obscure symptoms of disease and be not perceptibly affected by it, but quite able to transmit it to other kinds of which there is a large number at the Station susceptible in various degrees. Some of these may pick it up and tops be sent out to plantations before the presence of a new disease is realised. If the disease is infectious serious injury or much trouble and annoyance may result. The moral of which is, raise your own seedlings and be very chary of introductions. Australia and Fiji have suffered more from diseases carried in foreign canes than probably any other cane-growing countries. An instructive series of articles by Mr. North, plant pathologist of the Colonial Sugar Refining Company, have appeared in recent numbers of the Australian Sugar Journal dealing with this aspect, and detailing the new methods now being tried out or proposed in Australia to avoid the Experiment Station danger.

Sir Francis Watts: Mr. Ashby's paper is a very powerful warning—something that we should keep in mind. I do not know if anyone wants to speak on it as it does not affect us as yet.

Hon. A. E. Harrison: I would like, sir, to say this in reference to the paper just read by Mr. Ashby about these new diseases. We have already so many diseases attacking us that I cannot help thinking they should bring very forcibly before us the need for this Imperial College of Agriculture in the West Indies. We know what happens when we upset the equilibrium of nature, where agriculture is concerned; the insect enemies which we raise up and which we must be prepared to meet and fight. I only like to say that having heard that paper one must realize how very necessary it is for us to do what we can to get that College started and to get it as perfectly equipped as possible to carry on the work against these enemies.

"BOTANICAL NOTES ON SUGAR CANE."

BY

S. C. Harland, D.Sc. Lond., F.L.S., F.E.S.

In spite of the large number of workers who have devoted attention on the sugar cane plant there are still large gaps in our knowledge of its

morphology, physiology and genetics. It may be useful to devote more time to an outline of these gaps for it is only by taking stock of the present position that any improvement can be effected.

Morphology.

There is at present no entirely satisfactory classification or method of classifying sugar cane varieties. This leads to endless confusion in nomenclature, and some names for varieties, such as Bourbon, are probably names for groups of canes possessing the same general characters, instead of being confined to single pure vegetative lines. To be satisfactory a classification should be based rather on reliable biometrical or statistical measurements made under definite conditions, or in terms of genetic constitution. The qualitative characters of canes are often extraordinarily elusive and in different varieties and under different conditions, grade into each other to a considerable extent.

Physiology.

The new physiological conception of a living plant as a machine which elaborates organic compounds, such as sugar, from inorganic compounds, makes it necessary to study not only the mechanism by which sugar is built up in the plant, but also the relation of the plant to its environment. This study of the dynamics of living plants involves also the study of outside things as the water supplying power of the soil, the effect of temperature, atmosphere, humidity and solar radiation on the behaviour of the sugar cane plant.

Genetics.

Any plant may be regarded as a complex of herditary entities known as Genes which interact with the environment to produce a given type of plant. Unless the breeding of sugar cane is based on a knowledge of its Mendelian behaviour, the results, though undoubtedly possible, will hardly reach the same goal as a programme of constructive breeding work by which, little by little, a type of plant is synthesised which will interact with any given environment to the best advantage. So far as the writer is aware, there are no published investigations on Mendelian heredity in the sugar cane and therefore a rational basis for breeding work is entirely lacking. To sum up: existing knowledge of the sugar cane plant may be compared to the information which it would be possible to obtain from a dictionary if 90 per cent. of the pages were torn out. There is a vast literature on the technological side of sugar, a great deal of information is available on the fungus diseases and on the insect pests of sugar cane, but when it comes to knowledge of the plant itself we are confronted by a biological Sahara in which a few workers, such as Dr. Baker in India and a few Dutch workers, have been able to create minute oases.

At the Imperial College of Tropical Agriculture we have outlined a programme of research on the sugar cane which may be briefly stated to consist in obtaining answers to a series of questions: such as the following.:

1. What is the basis of drought resistance in cane?
2. What type of cane can utilise soil water most profitably in building up plant substance?
3. What effect has environment on the mere number of stomata, on photosynthetic activity and on carbohydrate metabolism?
4. Is it possible to analyse a character such as ratooning power in terms of Mendelian factors?
5. What is the maximum to which the juice content of cane can be raised by selection?

6. Is it possible to combine the resistance to Mosaic disease of the Uba and other canes with the desirable agricultural qualities of West Indian seedlings?

7. Do seedling canes run out? If so, why?

One could multiply questions of this kind almost indefinitely but unprofitably at this time. Attention will, however, be concentrated at present on lines of work immediately profitable from the economic point of view.

It was stated earlier in this paper that nothing was known of heredity in the sugar cane. We have obtained at the College a definite case of Mendelian behaviour in that seedlings from certain varieties show segregation of leaf colour in the rates 15 green to one albino. This means that there are probably two definite Mendelian factors for green leaf colour. If the maximum development of green colour in the leaf were shown to be most desirable for sugar elaboration one seedling out of 15 would breed true to this condition, and a race of pure dark green could thus be obtained without much difficulty.

Some attention has been given to a morphological character of sugar cane which has hitherto received no attention, namely, the number of nodes produced by a cane before it ripens.

It has been found that marked differences exist in different varieties in this respect, some varieties consistently producing more nodes than others. The effect of a morphological character such as this on yield is worthy of further investigation, and raises the point whether different parts of a sugar cane stem when used as cuttings will ripen after a definite number of nodes has been produced. In some plants an analysis of the morphological characters so far as they affect yield has been made and it would be a great value to carry out similar work with sugar cane.

Sir Francis Watts: Does anyone wish to ask Prof. Harland anything with regard to the points raised? He has indicated what has been done and what is to be done, pointing out the gaps that exist. When we have bridged these there is no doubt the benefits resulting from our knowledge will be much accentuated.

"SCIENTIFIC RESEARCH IN CONNECTION WITH THE SUGAR INDUSTRY THE MEANING AND NECESSITY OF RESEARCH."

BY

R. G. W. Farnell, B.A..

I am addressing you on a subject which hitherto has not received the attention deserved by the Sugar Industry. I refer to Research which can broadly be described as the furthering of our knowledge and understanding of Nature's laws.

It is the custom to distinguish two forms of research, pure and applied, though each is in a part dependent on the other, as I hope to show you, and I cannot do better than quote part of a letter written by Sir Michael Sadler (then Vice-chancellor of Leeds University) to the Manchester Guardian in 1917—"Pure science is the acquisition of knowledge for its own sake without express reference to its use. Applied science was nobly defined in 1828 to the Institution of Civil Engineers as "The art of directing the great sources of power in Nature for the

use and convenience of Man." Applied science derives most of its strength from pure science, pure science a part (though only a part) of its vindication and encouragement from applied. The difference between them is less one of subject matter than of nature. Either isolated from the other is weakened through lack of contact with the characteristic virtues of its opposite. Both may form part of the life-work of a single investigator. In both the Universities should participate, because it is the function of Universities, at one and the same time, to widen the boundaries of knowledge and to show how knowledge can be used for the welfare of mankind.

Innumerable instances can be given of discoveries which at first appeared to be mere freak curiosities but which sooner or later have been applied to utilitarian ends. I need only mention wireless telegraphy, X-rays, Ramsay's discovery of helium, the hardening of vegetable oils, the Haber synthesis of ammonia,—the tale could be infinitely extended these invaluable possessions, affecting millions, are based on the work of scientists experimenting in University laboratories, and inspired by that guiding principle of ever searching for truth and new knowledge.

Again, pure science has not infrequently derived a stimulus from applied. The process of soap boiling, discovered in the middle ages, has engaged the attention of McBain, who has recently developed his hypotheses into laws affecting the whole realm of colloid science. The Solvay ammonia soda process and the working of the Stassfurt deposits gave great impetus to the study of the phase theory, a theory profoundly affecting industries, including the sugar, in connection with the formation of molasses.

When we turn to the sugar industry, and especially the cane sugar industry we find much the same condition as that of a man living on his capital. In all fundamental respects the manufacture of raw sugar is the same as nearly 50 years ago. Defecation of cane juice by the application of lye and heat was practised by the Egyptians in the 8th century. The original process is still used in India and China for the manufacture of jaggery. Wood ashes were superseded by lime about the year 1750, and lime still to this day remains the only substance in general use. Steam heating was first employed in 1785, and three roller mills introduced in 1794, and are still seen in operation. Evaporation in vacuo was invented by Howard about the time of Waterloo, while multiple effect evaporation, a most fundamental advance, was the product of a French genius, Degraud, in 1836. In 1846 a patent was granted to Hardman for protecting his invention for the centrifugal which he termed "molasses-disperser". Wood charcoal was first used in the industry in 1812 while in 1815 Martineau patented the use of animal charcoal for refining and clarifying sugar. Sulphitation, suggested by Proust in 1809, was introduced into the industry by Melsene in 1849. Carbonitation, originally used in the German beet factories was extended to the cane industry by Pellet and was working in Java in 1878.

After this recital of dates one cannot well dispute the fact that for the last 50 years the Sugar Industry generally, and the British especially, has been living on the capital of their forefathers' inventive genius.

Let us now examine a few other industries. Take first the case of Rubber. The enormous development here is common knowledge. While the world production was only 8,000 tons in 1910, in 1923 the consumption of raw rubber in the U.S. alone has been estimated at 325,000 tons. Although chemical and physical research into rubber

only began about 1909 great strides have been made in our knowledge of the properties of raw rubber and vulcanisation. Much the same tale can be told of the automobile industry, the photographic industry, while such discoveries as that of manganese-steel by Hadfield can only be called as epoch-making.

Let us turn to Germany and her dye industry. The enormous dye trust familiarly known as the "I.G." could never have attained to the position of a minor Power but for the constant unceasing prosecution of research carried out both in University laboratories and special laboratories attached to the dye-works. Sir William Perkin first discovered an aniline dye in 1856 when but 17 years old. We certainly cannot overrate his genius, but the subsequent development of the industry by Germany and German research ranks among the greatest achievements of organised science. Incidentally this organised chemical research enabled Germany through the I.G. to produce not only all the synthetic ammonia and nitric acid necessary for explosives, but also practically all the chemical products needed during the war.

And what research has been done in connection with the British Sugar Industry during the last 50 years? From the biological side the history is not so disheartening. We need not refer here to the discovery of seedling cane, and the work of Harrison, Bovell and Barber, known all over the world. But with regard to the general ecological study of the cane we have left too much to the Dutch.

For systematic investigation on the manufacturing side, with one or two notable exceptions, we have been content to rely on the efforts of Dutch, Germans and Americans, and not only for research but also for the supply of trained technologists to operate our factories. In Java there are three stations, chemical, technical and agricultural, similarly in Hawaii, and in Louisiana there is the Audbon sugar school which sends technologists to sugar producing countries all over the world.

The Central Powers have not turned deaf ears to the claims of scientific research. In 50 years by patient cultivation and selection the sugar content of the Beet has been raised form 10% to 18%. Last year saw the opening of the new beet sugar research institute at Prague, Czecho-slovakia. Here will be carried out research into every department of beet sugar manufacture.

As an instance of our wholesale neglect of scientific research, the case of the Uba cane in Natal affords a good example. Although this cane seems immune to Mosaic disease yet in Natal at any rate the juice is of such a poor and unworkable quality that at a recent meeting of the Sugar Association of South Africa it was stated that reliance on the Uba cane was a handicap of from 15% to 20%. Yet there has never been made a systematic investigation of the exact character of Uba juice which may or may not differ fundamentally from the juice of cane of the Bourbon type. Again the Uba cane in Natal may not be identical with the cane that goes by that name in the West Indies, and here a morphologist is necessary to settle the taxonomic description of sugar cane varieties.

Having touched briefly on the need for extended research in the British Sugar Industry on account may now be given of the recent development in England of State-aided Research and its effect on industry generally and especially the Sugar industry.

II. The British Empire Sugar Research Association.

Early in the war it became apparent that the economic battle after the conclusion of hostilities would be as intense and important for Britain

as were the military engagements to which she was then committed. Consequently there was appointed in 1915 a small advisory council to report on the methods by which scientific and industrial research could be developed. As a result of their recommendations Parliament instituted a Department of Scientific and Industrial Research, and voted a large sum for aiding research. The function of the Department was to encourage and partially organize the research in three directions:—

(1) The encouragement of research workers by grants.
(2) The organization of research by industries.
(3) The organzation of national research.

With regard to (1) it was obvious during the war that there was a great shortage of research wrokers, so the Department assisted those students to begin research who had already undergone the preliminary training in Universities and Technical Colleges.

Taking next the organization of national research, this entailed setting up a clearing house of information, assisting special research carried out for Departments of State, and the institution of Research Boards to deal with subjects that affected everyone and that were too vast to be tackled by any single industry. Several of these Research Boards are now in operation and include the Fuel Research Board, the Building Research Board, and the Food Investigation Board.

We turn now to the second function of the Department, that is the organization of industrial research. The department decided to encourage industries to organize themselves for the purpose of carrying out co-operative research. Thus the scheme was instituted for the establishment by industries themselves of non-profit sharing companies, registered under the Companies Act, and having powers to research and to aid education. These companies are known as Research Associations. Before a Research Association can obtain a grant from the million pounds specially allocated by the Department, guarantees must be given that the work shall be continued for five years. Also the Department insisted that the members of a Research Association should raise among them a minimum income the amount of which varied with different industries. Against this income it made a grant of pound for pound. The Department laid down that at all times the Research Association was to have a Director of Research and that a general research programme must be drawn up. Information gained by the Research Association was immediately to be put before its members. After an interval it could be published in the usual technical journals. If, however, an important discovery was made which would have immediate application it was to be reserved exculsively for the members, and not made available to the general public until a sufficient time had elapsed in order to guard the members' interests. Regarding buildings and laboratories the Associations were advised to make as much use as possible, at any rate during the first stages, of existing institutions, and later when funds permitted a separate research institute could be built. Having now touched on the history of the inauguration of Research Associations which this year number 24, let us turn to the British Empire Sugar Research Association which received its license in 1919. The aims of the Association were to establish in co-operation with the Department of Scientific and Industrial Research, an Empire scheme for the scientific investigation either by its own officers or by Universities, Technical Schools, or other institutions, of the problems arising in the sugar industry, and to encourage and improve the technical education of persons who were, or were going to be engaged in the industry. Unfortunately, the appeal for subscriptions coincided

with the slump of sugar and it was soon evident that the original scheme would have to be modified considerably. At the end of 1921, however, a start was made on a very modest scale and it was decided to employ a research chemist who visited the West Indies. That is the present position of the Sugar Research Association. Its activities, through restricted, have not by any means been suspended and a study has begun of the various colloids of cane juice, to which reference will be made again.

Now in the organization of research there are two methods. The first is to make a frontal attack on problems, that is by the methods based on the experiences of the past, whithout neces-arily studying fundamental nature of the processes involved. This t as been the practice accepted almost without exception in the Sugar Industry, to tackle problems as they arose. Manufacturing difficulties nearly always devolved on the factory chemists who too often had neither the time nor the training to elucidate the true nature of the problem involved, and push it to its successful solution. The second method is more general in scope and relies in the first instance on increasing our knowledge of facts. At this stage the research is more in the realm of pure science. Having discovered what are the true facts we can apply our new knowledge and devise practical means to solve the original problem. The frontal attack is not so successful in the long run as the second method which we may call the flank attack, and the method by which the Sugar Research Association intends to benefit sugar industry.

Let us now consider the organization of the Research Association which the British Sugar Industry deserves, and which, but for unfavourable circumstances it might have got.

The sugar industry differs from other tropical industries inasmuch as the sugar industry estate is a self-contained unit, producing an article which can either go direct into consumption and be retailed immediately, or else suffer a simple refining process before disposal. Contrast this state of affairs with the British Cotton Industry. Here the raw material, coming principally from America and Egypt is spun, woven, bleached and dyed within a camparatively limited area in the north of England. The organizers of the British Cotton Industry Research Association concentrated on a central research institute, the Shirley Institute, at Didsbury, Manchester. At the same time provision was made for research to be carried out in the cotton growing regions.

When we come to devise the constitution of a more extensive Sugar Research Association, we are at once involved by the very nature of the industry, including as it does, both self-contained estates all over the world, and the refineries in England and Scotland.

We may lay down the following requirements for the proposed Research Association:—

(1) An experimental station somewhere in the tropical or subtropical Empire, in close proximity to some existing institution equipped with laboratories.

(2) In connection with the Experiment station a small model factory to investigate new and existing processes for the manufacture of sugar and disposal of by-products.

(3) A laboratory in England to study the many subsidiary problems of the industry, especially those of the refiner. In association with this laboratory it would be necessary to have a records office and intelligence bureau.

At the experiment station and in connection with the laboratories we could investigate the nature and nurture of the cane. By nature we must include the inherited tendencies of the cane, such as resistance to disease, sucrose and fibre content, length of internode, also the inheritance of the various substances injurious to manufacture, such as pectin, pentosan protein and wax. It is clear that this work, devolving in the first instance on the geneticist cannot proceed very far without the assistance of biochemists, etc.

By nurture we mean the effect of environment on the cane, and here we must be able to control this environment, especially in regard to soil and water supply by isolating the cane in tubs and soils. We need here the co-operation of plant physiologist, soil scientist, biochemist, microbiologist and entomologist.

Again, colloid chemist, biochemist, physicist and technologist must research and apply their own, and knowledge gained elsewhere by others, to the elucidation of the problems of manufacture: problems apparently simple, in reality more complicated, since they deal with complex systems containing sugars, acids, colloids, mineral matter, all of which can vary individually.

The function of the chemical laboratory in England (using chemical in its broadest sense) would be largely to keep in touch with any research carried out elsewhere that had a bearing on the sugar industry. The preliminary study and application of this research could be carried out here. An important function of this laboratory, as already mentioned, would lie in the direction of refiners and refining problems, and also problems connected with the use of sugar and sugar products. We will not here concern ourselves with the beet sugar industry, though if this is developed in England, as seems possible, this laboratory would be enabled to study some of the manufacturing problems concerned.

The records office and intelligence bureau would serve as a central clearing house of information. Here would be indexed the results of any international research having any bearing on our industry. The amount of the world's research grows enormously every year, and it must be sorted out and made available in the proper direction.

Such is the outline of the Research Association necessary to deal with the problems of the Sugar Industry in an adequate manner.

It may be asked, "What results are to be expected from the Research Association, and how can it benefit the Industry?"

In answer to this let us first examine what existing stations have done, stations working principally on the improvement of the sugar content of the cane, and its resistance to disease. Barbados furnishes a good example. Mr. Bovell calculates that simply by replacing the White Transparent variety by three of his seedlings, the planters have reaped a direct profit of over £4,000,000 withhin the last eight years. Similarly in Argentine it has been estimated that by introducing Java seedlings the planters of Tucuman are saving £5,000,000 p.a.

In Java, the results have been even more striking. From 1886, when the first experiment station was founded, the average production has increased from 2.75 tons to 4.0-5.0 tons of sugar per acre, some varieties giving over 6 tons. The value of these new seedling canes have everywhere been admitted by direct financial returns, but the time has come to take a broader, more comprehensive view of the possibilities of sugar research.

As an example of what research can do in a somewhat unexplored field, let us take one or two cases affecting manufacture, and first the

simple defecation of cane juice by lime and heat. Of the chemical and physical changes involved in defecation we have much to learn. For example it was always thought immaterial whether the lime was added to the cold juice which was then brought to the boil or whether the lime was added to the boiling juice, Some might say that the latter method of "liming hot" would invert part of the sucrose. This however is now generally recognized not to be the case, owing to the very slight acidity of the raw juice (when expressed in terms of hydrogenion concentration) and the short interval of time (22-3 minutes) during which the juice is heated. Now in the case of cold liming the juice is boiled practically neutral, while by liming hot the juice is boiled while still acid. In the first case, less protein is coagulated than in the second case, for the albumin is coagulated much more completely from acid than from neutral solution, and moreover lime and lime salts inhibit the coagulation of the albumin. It is very desirable to remove as much of the protein as possible for it is one of the principal colloids of the juice, and is responsible with the other colloids for the viscosity of syrups and molasses, and is one of the factors preventing the crystallisation of sugar.

While sugar chemists have never withheld their abuse of these colloidal substances which they usually class as "gums," there has not been any systematic study made of them, except in Java where investigations are now proceeding. The Research Association has begun a preliminary research on the colloids of cane juice which we find to consist generally speaking of pectin, pentosan, (the principal constitutent of cane gum) protein, tannin, cane wax, and possibly silica. The pectin is partly removed in alkaline clarification but this does not remove the pentosan at all, which in the defecation process continues through manufacture till the final molasses. In the carbonatation process, however, where a granular precipate of calcium carbonate is formed in the juice, much of this pentosan is removed. We have already touched on the protein in connection with "hot liming". The tannin of the cane is mainly responsible for the colour of cane products, since its iron salt makes an excellent ink. We know little about the removal of tannin except that like all colloids it can be absorbed to a certain extent by activated carbons, and in fact solid surfaces generally. The importance of cane wax in clarification does not seem to have been sufficiently appreciated. When melted it forms an emulsion with the juice and is found in appreciable quantity in the molasses.

There is no doubt that defecation, sulphitation, carbonation, and activated carbon processes must all be examined from the colloid chemical aspect. Work on these lines cannot fail to be of lasting importance to the industry.

Is the sugar industry peculiar in that it can afford to neglect scientific progress? That the benefits of pure as well as applied science have been recognized in some quarters we need only mention a few outstanding examples.

Messrs. Brunner Mond, alkali manufacturers, recently gave £100,000 to British Universities for the encouragement of scientific research. The General Electric Co. of New York similarly £1,000 to the Cavendish laboratory, Cambridge, for promoting research there. This same firm spends from £50,000 to £100,00 p.a. on research alone. The Eastman Kodak Co. spend 0.7% of their profits on scientific investigation.

When the Cotton Industry Research Association was instituted the levy taken amongst manufacturers amounted to about one-tenth of their annual fire insurance. Surely insurance against ignorance is cheap at this price? The object of scientific research in the sugar industry is

not primarily financial profit, this accruing incidentally, it is to build up a strong and progressive industry, and to enable the sugar trade to tact competition fearlessly, because it will then be firmly based on knowledge.

Herbert Hoover, Secretary of the U.S. Department of Commerce recently said:- "Industry and commerce have grown rapidly in recent years in their appreciation of the fundamental contribution of pure science of both chemistry and physics. The great increase in private research laboratories, the fine support of our public institutions is the mark of this realisation. Discovery and invention are now no longer the function of the garret genius. They are the result of deliberate organised exploration by our men of science. New discoveries and their application will come faster and more securely than ever before and I believe the next half century will be greater in its triumphs of science and in their contribution to human welfare than even the last fifty years —for we are better trained, better organised, better equipped for discovery than ever before."

Sir Francis Watts: Mr. Farnell has outlined in a general way, information as regards his researches in relation to sugar, and sugar cane for the manufacture of sugar. I may explain that he is the chemist appointed by the Sugar Research Association to investigate these things. He came out to the West Indies and was afforded every facility at the Imperial College of Agriculture where he has carried out his work. He has published various papers and has others in course of preparation. He has also given some attention to the manufacture of sugar. He ceases to remain with us at the Agricultural College, and after his return to England will go on a tour to increase his knowledge. Among other places he will visit Natal, Mauritius, India and Java. What they will do with him after that I do not know, but he is so charged with knowledge of the sugar industry, that you have only to shake him up on the various points, to get the desired information from him. I have not the slightest doubt that a great deal that is valuable will be the outcome of his investigations at the Imperial College. I take some little credit myself for Mr. Farnell being here. It was intimated to me that a large programme was planned with regard to the British Empire Sugar Research Association, and which it was found impossible to carry through, because money was not forthcoming to meet the requirements, but that the Department responsible had been asked to give a grant to the Association. Sir Edward Dawson, who is very much interested in the work of the Association in England, approached me, asking me what could be done for the British West Indian industry. I suggested that we carry out research by getting one worker or two, and see what could be done. We hoped that his work would be of such a nature as to inspire confidence in those interested in the sugar industry, and make it worthy of support. We approached Sir F. Keith, the Secretary of the Association, who was able to get sufficient money to get it started, and started Mr. Farnell on his voyage round the world.

Capt. Hill: This is quite outside the different botanical matters that come within my life's work, and I cannot say anything on it. But I do think this is most important work that can be carried out in connection with such a product like sugar which we have been dealing with. Sugar is one of the staple things on which so much depends in our Empire, and one of which, as in the case of other of our important staples, we know so little. We all know during the war how extremely scarce were all the things which lead to our welfare, and the inconveniences we suffered therefrom in these staple highly important industries. I think Mr. Farnell's work and his vast capacities for undertaking this work

are going to give good results. And they also show us the need for, and the great value of, such a thing as a tropical laboratory to carry out these absolutely essential researches to our industry. We can have this work at Trinidad to carry out researches in this matter, enabling us to provide and increase the basis for compiling the scientific facts in the sugar industry and enabling us to make progress.

Sir Francis Watts: Mr. Farnell will read a short note by Prof. Dash with regard to the experimental station in the neighbouring French island of Guadeloupe of which he was in charge. I think it is interesting enough to have it read at this meeting.

"THE GUADELOUPE EXPERIMENT STATION 1918-1919: ITS ORGANIZATION AIM AND PROBLEMS."

BY

Professor J. Sydney Dash, B.S.A.

(Communicated by R. G. W. Farnell, B.A.,)

(Summary of the above paper.)

During the year, 1917, the sugar planters of Guadeloupe finding their industry threatened by continued low fields and factory returns, on the advice of Mr. J. R. Bovell of Barbados, decided to create an Experiment Station of their own without government aid. The writer was invited to organize and direct the new station. An association was formed among the leading sugar companies binding themselves to support the establishment for a period of five years at first. A sum of 250,000 francs was determined on as the capital necessary for the end in view, each member being assessed pro rata on the average number of tons of canes produced or manipulated during the five years preceding, 1913-1917. Thereafter, the association would meet annually to vote the expenditure and to settle the year's contribution of each member along similiar lines.

As this was the first association of its kind in the Lesser Antilles, the articles, which were published in French in one of the early reports of the station, are included for reference.

A general account is given of the conditions of the sugar industry in this Colony and the ways in which the stations set itself to render immediate practical assistance to the growers. The nature of the problems faced and the difficulties encountered are all set forth. In addition, the investigational side of the work was developed to the fullest extent possible. Among the more important of the projects launched were: introduction of new varieties of sugar-cane; raising and testing of sugar-cane seedlings; variety and manurial experiments with sugar-cane; study of problems connected with soil fertility, rotation crops, green manure crops and forage crops; study of tillage methods and implements; study of plant diseases and pests; statistical work and the publication of reports, journals and other information for the benefit of planters. Mention is also made of the efforts to improve general livestock conditions.

A special feature of the work was the maintenance of close co-operation between the station and the various local centres, which were frequently visited and discussions held. The station also acted as an intermediary for members of the association wishing to get in touch with firms or persons unknown to them.

In conclusion, some of the principal achievements are pointed out, and reference is made to the fact that at the end of the five years period the results were such as to justify the continuance of the station.

Mr. Watts: This is simply put forward as another development of efforts made in another colony to help themselves without Government assistance or support to assist the scientific investigation station which is doing very good work. I think at this stage we will suspend some of our discussion about sugar, and that we will deal with group subjects relating to experiments. In addition to the subjects on the agenda, Mr. Moody Stewart has promised to read a short note, it will only take about fifteen minutes, with regard to modern methods of sugar manufacture. He is not present just at this time, but might be here in a few minutes. In the meantime, I suggest that we take up one or two of the subjects put down among miscellaneous. I will be particularly obliged to Mr. Nosworthy to give us his paper relating to the minor industries in the Leeward Islands. Mr. Nosworthy is specially fitted to report on the Leeward Islands conference, as for some considerable time he was the able and efficient administrator of one of the islands in that group.

Capt. Hill: There is a matter I would like to bring forward. Looking at the newspaper report of my address I see a mis-statement—probably a misprint due to the difficulties of my writing—which possibly might cause annoyance. What I did say with reference to our flora in the different parts of the world was that we did not desire to see the colonies becoming appanages of the United States. In the newspaper I see it reported that we do not desire to become orphanages of the United States (laughter). It may give rise to some misunderstanding and I would be very much obliged if it were corrected.

Sir Francis Watts: Owing to the difficult acoustic properties of the building, I am surprised at the reporters being able to be as correct as they have been.

"THE INDUSTRIES OF THE LEEWARD ISLANDS."

BY

THE HON. R. NOSWORTHY.

I have been asked by the Governor of the Leeward Islands through the Secretary of State for the Colonies to represent those Islands at this Conference. For nine months 1922/23, I acted as Administrator of Dominica and became interested in the welfare of those islands generally. I have not failed to observe the very critical condition of the market of their staple industries.

Although one often sees advertised Montserrat lime juice, almost all the West Indian Lime trade is confined to Dominica, Lime Tree products being the main Export from that Island. Of the £150,213 representing

the value of the 1922 exports no less than £131,016 come under this class as under:

	Quantity.	Value.
		£
Concentrated Lime Juice ..	162,222 galls.	44,611
Raw Lime Juice ..	286,782 "	17,924
Lime Juice Cordial ..	4,226 "	911
Fresh Limes	24,389 brls.	23,225
Pickled Limes ..	444 "	450
Citrate of Lime ..	6,450 cwts.	22,575
Citric Acid Crystals ..	38,864 lb.	3,400
Essential oil of limes ..	76,150 "	7,615
Otto of limes	24,267 "	10,305
		£131,016

It therefore will be seen how vital for the future of Dominica is the fostering of this Industry.

During the past few years, however, the trees have been attacked with the Withertip disease which threatens the most serious consequences to that Island. Professor Ashby has already furnished full information regarding this pest. The Assistant Curator of Dominica was sent to the United States of America and the Department of Agriculture in Washington afforded him every assistance in learning how the evil was controlled in the groves in Florida. Indeed so attentive were they to him that, discovering the worth of the training he got at Kew, they offered him a position in their Department far more remunerative than Dominica could afford, and he is now permanently there.

I was pleased to note from Circular of the West India Committee that the fear that recent action of the United States meant an embargo on the introduction of Limes into the Country had been removed. Fearing that their principal product was threatened with disaster, a local Company has been formed to push Banana cultivation in Dominica. When there I traversed a plateau of some 2,000 acres of excellent virgin land within easy access to a Port which, from knowledge acquired here (Jamaica), I considered adaptable for Banana cultivation, and later I found official reports made by the local Curator, a Curator from Grenada and a representative from Messrs. Rowntree, Ltd., expressive of the opinion I had formed. I am exceedingly sorry that the banana expert sent by the United Fruit Company to explore the Islands did not extend his visit to Dominica. It is however essential that shipping facilities should first be secured.

The main products of the other Islands of this group are Sugar as regards Antigua and St. Kitts, with cotton as a subsidiary, whereas in Montserrat, Nevis and Anguilla, Cotton is the only cultivation of importance, and one of the chief points which the Colony desires brought to the notice of this Conference is the depressed state of the Sea Island Cotton industry, and to see whether any remedies can be suggested. From reports sent to me, I gather that this description of Cotton, acknowledged to be of very superior quality, has so declined in price as to remove all profits from its cultivation. This is due to the severe competition with artificial silks. Owing to this competition with artificial silks, especially of the type of "Celanese" silk (manufactured by the British Cellulose & Chemical Manufacturing Co., Ltd.) which are gaining in favour over high grade Sea Island fabrics—it does not seem

likely that the demand for Sea Island cotton will increase and there appears no likelihood that the price will go much beyond rates, it may possibly be established at, about 1/6 per lb., a rate at which planters claim it does not pay to grow this crop. The price of this description of Cotton is now the same or less than it was in 1914 and no higher than the inferior Upland, whereas it is well known how the cultivation expenses everywhere have increased. In Antigua the cultivation has fallen from 2,508 acres in 1908 to 396 in 1921 and in St. Kitts from 5,000 acres in 1919 to 3,000 in 1921, whilst Monsterrat is most seriously affected this being practically its only product. I am informed that this description of cotton cannot be grown at less than from 1/9 to 2/- per lb. whereas the price now offered is only 1/7. Then again this industry has been more seriously damaged by the pink boll worm, notwithstanding the efforts taken to control its ravages by the dusting with Paris green and lime, and by the burning of all old stalks during the close season. I should like this Conference to consider whether there is any type of Cotton immune from such pests. I am made to understand that the Imperial Department of Agriculture have recommended a trial of a new type known as West Indian Superfine Jannovitch, but the Sea Island is a crop growers know and are accustomed to its foibles, and in the main it would be more satisfactory if remunerative prices could be secured for it. It certainly is of utmost importance for Montserrat, Nevis and Anguilla that an endeavour should be made to fix a minimum price to secure a continuance of the cultivation in these islands where it is the sole industry of the peasantry.

As I have remarked the cultivation of cotton in Antigua and St. Kitts is relatively small, being a subsidiary industry on sugar estates. Under such conditions Sea Island or any suitable variety would be grown when the prices of sugar are low and those of cotton relatively high. It would be well for Montserrat and Nevis if the Cane Industry on modern lines could be established there and in this way dependence on cotton lessened. If small modern Co-operative Factories could be established with Government assistance and of course with the exercise of some Government control, it is believed that a sufficient supply of Canes would readily be supplied. In this way these islands would be put on the same footing as the large ones.

If this be not found possible I would ask the Imperial Department of Agriculture to consider what alternative industries the Agricultural Departments of this Colony of the Leeward Islands should experiment in. Those that suggest themselves to me are increase in Tobacco cultivation which is now being tried in St. Kitts, Fibre Plants, Annatto; Bananas should also do well.

I think it will be found that it is very necessary to encourage subsidiary industries throughout these Islands, amongst them that of fresh fruit. At present Dominica exports a fair amount of Mangoes, Avocado Pears, etc., but this is confined to the neighbouring islands. The Dominica fruit is exceptionally fine, and this industry might well be extended and made very profitable. I need not say how essential it is that regular Steamship Service with cold storage accommodation should be arranged for. I feel sure that a combination among the West Indian Islands could maintain such a Service with freight and passengers to Canada, United States of America or England.

I ask leave to lay before you as further information on this subject a precis prepared by the Superintendent of Agriculture, Antigua, on the present critical position of the Sea Island Cotton Industry in the Leeward Islands, together with similar reports from each Presidency.

"THE PRESENT CRITICAL POSITION OF THE SEA ISLAND COTTON INDUSTRY IN THE LEEWARD ISLANDS."

BY

THE HON. A. E. COLLENS, Govt. Chemist, Leeward Islands.

(Communicated by Hon. R. Nosworthy.)

During the past two years considerable apprehension has been felt in the Leeward Islands in connection with the Sea Island Cotton industry and this feeling has been considerably increased by the very low price, viz: 1/4 to 1/6 at which much of the crop grown this year has been sold.

While cotton generally is still much above pre-war rates and Upland cotton especially which is now quoted at 1/7 to 2/ per lb. as against 6d. in 1924, Sea Island cotton has experienced a reverse the price now obtained being equivalent to that of pre-war days (from 1910 to 1914).

Growers complain—and with considerable justice too—that at the present rate it is impossible to make the crop a paying one.

Handicapped by a series of dry years since 1919, the attacks of cotton stainers and cotton worm and latterly since 1920 the pink boll worm, the position becomes increasingly difficult. Low yields have been experienced in the majority of cases, for instance in the present year the yields in Nevis varied from 40 to 80 lb. of lint per acre and in many cases less and only one or two planters were lucky enough to get over 100 lb. lint per acre. At this rate of yield and the poor price obtaining it cannot pay to grow cotton, and as a natural resultant the financial position in Nevis is a serious one. Cotton is the main crop and owing to local circumstances must continue to be so and planters are hard put to find money to maintain proper cultivation.

One striking feature about cotton is that it is a peasant crop as well, that is, small growers can get as good results and produce as fine a cotton as large growers, and accordingly in most of the islands it is also cultivated by the peasantry. This is a valuable feature, because it provides a crop with which they are thoroughly acquainted, and also in many instances it enables them to plant up lands which owing to their situation, etc. would not be utilised for sugar cultivation and which would in consequence remain idle. This is especially the case in Antigua and the Virgin Islands where the cotton industry is mainly in the hands of small growers. It is a striking commentary on the decadence of the industry in the former presidency to note that in 1908 the area under cotton was 2,508 acres and that in the present year only 396 acres were so cultivated. Most of the larger growers have abandoned the crop and only two or three moderately large growers remain. As a matter of fact were it not for the work of the Antigua Cotton Growers Association an entirely voluntary body and in no way deriving any pecuniary benefit—the industry would have died out in the past two years, with the probable result of an increased emigration of the peasant class—a feature which is already proving a severe handicap to local agricultural pursuits.

Since its first discovery in Montserrat and St. Kitts in November, 1920, the pink boll worm has considerably added to the difficulty of obtaining any large return of cotton per acre. By the middle of 1921 it has been reported from all the presidencies and its presence was soon

manifested by the cutting short or entire loss of any second picking and this unwelcome feature has now become a permanent one. As a remedial measure, close planting has been adopted and great hopes were expected from this but owing to the dry weather experienced in most of these islands during growing of the present crop the results have been in the main disappointing.

The Sea Island cotton industry is a highly specialised one, and has been encouraged and developed entirely through the good services and assistance of the Imperial Department of Agriculture, who first introduced this crop about the year 1900.

The greatest care is taken to maintain a high grade cotton and a special selection of seed is yearly carried out. Each year a selected type is grown at the various Experiment Stations which is again selected and planted on a field scale; in the third year this seed becomes available for planters. This process is carried out every year and by this means a high standard of the type of cotton best suited for each island is maintained.

An assiduous war is maintained against cotton pests by dusting with Paris green and lime for cutworms—in most of the islands a reserve stock of Paris green is kept by the local Agricultural Department in case of any local deficiency, while the pink boll worm and stainer are kept under control by a close season usually of one month's duration, previous to which every cotton stalk, etc., must have been burnt. The pink boll worm is also controlled by the daily fumigation of cotton seed at each Ginnery. This work is under the supervision of the local Agricultural Departments who carry out frequent inspections and check up the quantity of carbon bisulphide used in the fumigation.

It will be seen that every care is taken to maintain a high grade of cotton and to reduce as much as possible the ravages of pests.

Under existing conditons everything points to the probable abandoning of this industry in the Leeward Islands and planters are inviting the services of the Imperial Department of Agriculture in suggesting and obtaining some other type of cotton which might be suitable for local conditions.

After careful consideration the Imperial Department of Agriculture has tentatively suggested a new type of cotton to be known as West Indian Superfine Jannovitch for two of the islands, and also a new type of Long Staple cotton for general cultivation.

The Sea Island type of cotton is however a crop we know, and growers of all classes are accustomed to its foibles, and it would be in the main more satisfactory if more remunerative prices could be offered for it. This, coupled with the slow rate of sales, has proved a considerable handicap to growers and especially the smaller ones, who cannot market their own produce, or even in many instances pay for ginning, and who are accordingly at the mercy of the intermediate buyer. In many instances planters still have on hand cotton grown in 1922 and even previously.

It is accordingly suggested that every effort should be made to obtain a guarantee of a fixed minimum price for a period of years and failing this that the industry be abondoned, and Upland or improved Jannovitch cotton be grown, in the latter case it would be highly desirable that some similar guarantee be obtained.

Note:—Since writing the above, recent information is available that the Fine Spinners have been approached by their representative in the Leeward Islands asking them to fix a minimum price for Sea Island cotton. Should this be successful and a minimum remunerative price

fixed for a period of years, the alternative of growing other types of cotton would not have to be considered.

Mr. Nosworthy also communicated the following papers to the Conference.

"MINOR INDUSTRIES FOR THE LEEWARD ISLANDS."

BY

A. E. Collens, F.I.C., F.C.S., Government Chemist and Superintendent of Agriculture for the Leeward Islands, and F.H.S. Warneford, M.A., B.Sc., A.I.C., F.C.S., Assistant Government Chemist, Leeward Islands.

(Communicated by the Hon. R. Nosworthy.)

The limitation and practical collapse of the market for Sea Island cotton during the last two years has proved a serious blow to all the presidencies of the colony of the Leeward Islands with the single exception of Dominica, in which Island this crop is not cultivated. More especially has this been the case in Montserrat and Nevis where cotton has for some time been the staple crop.

The appearance of the pink boll worm in the colony at the same time has further increased the difficulty of carrying on cotton cultivation with any hope of a reasonable profit.

In Dominica the poor market for citrus products has proved a serious danger which has been aggravated during the past year by the presence of the wither-tip disease of limes.

Throughout the colony, therefore, there is at present time a great need for the extension of minor industries. In the present paper, the writers purpose to touch briefly on certain new minor industries which might prove suitable for development in the colony, and on other industries which seem worthy of considerable extension.

Oil Seeds.

A. Coconuts.—Dominica and Nevis are the two largest producers of coconuts in the Leeward Islands, the total annual production in the former island being about 1,000,000 nuts. The area under coconuts in Dominica is estimated as over 1,000 acres and in Nevis at about 700 acres: in the latter island Pinney's Estate may be regarded as the chief coconut plantation in the colony. In Antigua only about 200 acres are planted in coconuts, while in the other islands the acreage is even smaller.

Considerable room for expansion exists in most of the islands. Coconuts will grow on most soils which have a good supply of moving water, that is to say, on plains sloping gently from the sea to high land in the interior and on sandy sea shores which are backed by higher land. Beaches which have lagoons behind them do not as a rule show a vigorous growth of coconuts, and marshy situations are unsuitable.

The largest area available would appear to be in Dominica where there is an abundant rainfall and where the palm thrives well up to 1,500 feet. Mr. J. Jones, the Agricultural Superintendent, advocates the extension of this crop in Dominica and suggests raising sheep between the young trees.

At the present time, the majority of the nuts grown in the colony are either used locally or in the neighbouring islands or are exported to the United Kingdom or the United States of America. Copra is, however, made to some extent in Dominica and in Nevis. In the event of any considerable expansion of coconut cultivation it is obvious that the greater part of the produce would have to be marketed either in this form or as coconut oil. A brief review of the modern methods for the preparation of these commodities may therefore be not out of place.

The methods of drying copra may be classed under three heads —sun drying, smoking and kiln drying. Smoking consists in drying the copra over open fires: good copra can never be made by this process. Sun drying is a lengthy process but good copra can be obtained by this method if the weather is favourable, and if the copra is kept from getting wet during the 4 to 7 days required for drying. Recently the Bureau of Science of the Philippines has evolved a modification of the sun drying process which ensures the production of good copra even under unfavourable weather conditions. The essential feature is the treatment of the husked and split nuts with the fumes of burning sulphur for about twelve hours before drying, which may then be carried out under if the weather is wet.

The largest portion of the world's high-class copra is kiln dried; numerous types of kiln driers are on the market. The following facts, in connection with the kiln drying of copra were established in a series of experiments recently conducted at the Federal Laboratory in Antigua:

I. During the initial stages of drying, which is best conducted in a current of dry air, the temperature may be kept between 73-82 degs. C. but towards the end of the drying process it should not exceed 66 degs. C. or there is likely to be a darkening of the copra owing to the caramelisation of the thin film of saccharine matter left from the coconut water.

II. It is impossible to make good copra from immature nuts. There is a high loss in drying and the resulting copra is dark in colour, opaque instead of transparent and has a low oil content.

Serious losses frequently occur owing to deterioration of copra by the action of moulds. All samples of copra, whose moisture content exceeds 5-6 per cent. are subject to mould growth. Below 7 per cent. moisture, however, the only mould found is a green mould (*Penicillium glaucum*) which is entirely superficial and causes little damage.

Dried copra is slightly hygroscopic; it will only absorb moisture, however when stored for some time in a saturated atmosphere. In practice this condition is seldom fulfilled.

Various primitive methods exist for extracting coconut oil from the fresh meat: these processes however give poor yields of oil of indifferent quality and most of the world's supply of the oil is expressed from copra.

The Philippine Bureau of Science, whose work has already been quoted, have devised a process which is stated to give a recovery of 80 per cent. of good oil from the fresh meat. The ground meat is treated with live steam for several hours in a vessel fitted with a mechanical agitator and the resulting emulsion strained and the residual pulp pressed. The emulsion resulting from the pressing is united with the strained portion and cooled to 15 degs. C. for 24 hours. The oil is thereby solidified and the water remains as a subjacent layer. The separated fat is melted and passed through filter presses to remove solid matter. The filtered oil is water white, free from objectionable odour, acidity and rancidity and is of good keeping quality.

Coconut oil finds a market in the manufacture of margarine and of soap. In 1922, the imports of coconut oil and copra into the United Kingdom were as follows:

Coconut oil unrefined, 28,549 tons; value £1,134,982.

Coconut oil refined, 9,841 tons, value £485,920.

Copra, 86,084 tons, value £2,150,620. Total, £3,771,522.

The prices of the crude oil and of copra were thus £40 and £25 per ton respectively. As the yield of oil from copra is in the region of 63 per cent., so that the oil recoverable from one ton copra should be worth £25, and as the coconut press cake is an extremely valuable food and manure, it would appear to be the more profitable to produce and export oil than copra, provided a market for the press cake can be easily obtained

B. Oil Palms—The African Oil Palm (*Elaeis guineensis*) is the source of two important oil products, palm oil and palm kernel oil, practically the whole supplies of which have come in the past from the West Coast of Africa. Recently, however, the Dutch have started its cultivation in Sumatra, and in 1922 the plantations in that island totalled 28,000 acres.

The oil palm requires a mean annual temperature of 71 to 88 degs. F. The optinum rainfall appears to be from 70 to 100 inches per annum spread over many months with frequent falls alternating with days of sunshine.

Oil palms thrive best in deep well drained soils, rich in humus and highly nitrogenous, but will grow on other soils provided they are not marshy.

The conditions of climate and soil are therefore such as can be obtained in parts of Dominica and Montserrat. It seems probable that in the latter island, the Montserrat Lime Juice Company, who have already erected a mill for crushing cotton seed for oil expression may be induced to give a trial to this crop.

In Dominica the chief difficulty in growing oil palms on a big scale would be the question of transport of the fruit to the factory. Hand machines for oil production on the small scale can, however, be obtained at reasonable prices.

The establishment of an oil palm plantation is somewhat more expensive than that of a coconut plantation, and the manufacture of the oil is more expensive than the manufacture of copra; the return from the oil palm plantation is, however, the greater of the two.

The cost of establishing the plantation can be partly defrayed by growing such catch crops as maize, pigeon peas and pine-apples, during the 5 to 6 years before bearing begins.

The oil palm as a rule starts bearing in the fifth year, but does not produce its maximum yield until after the tenth year. The following figures calculated from results obtained in Sumatra, and assuming an 80 per cent. extraction of the pulp oil, indicate the yeilds obtained per acre in that island.:

	Palm Oil.	Palm Kernels
	(tons.)	(tons.)
5th to 10th year ..	0.398	0.121
11th to 30th year ..	1.243	0.377
31st to 50th year ..	0.499	0.151

The average prices in the United Kingdom for palm kernels and palm oil during 1922 were £17 10/ and £23 12/- respectively. At these figures, the values for the produce of one acre become:

	Palm Oil.	Palm Kernels.	Total.
5th to 10th year ..	£13.4	£2.12	£15.52
11th to 30th year ..	41.8	£41.8	6.60
31st to 50th year ..	16.8	2.64	19.44

The demand for palm oil and palm kernels is considerable. The United Kingdom alone imported palm oil to the value of £2,341,729, and palm kernels to the value of £3,699,383 during 1922.

Palm oil and palm kernel oil are used in the manufacture of numerous products such as margarine, vegetable butters, soaps, candles, etc.

Although the market is large, it should, however, be noted that there is an abundant supply of palm fruits available in West Africa, large areas of forest being still untouched. Owing to their situation and cheaper freight rates, West Indian palm oil might, however, have an advantage over the African product in the American and Canadian markets.

C. Castor Seeds:—Two main types of castor seed, large and small are met with in commerce. The large type yields a slightly higher percentage of oil, but the oil extracted from the smaller type is considered more valuable and is largely used for medicinal purposes.

Local varieties examined at the Federal Government Laboratory contained the percentages of oil as under:

Antigua, small local type, 48.8 per cent. oil.

Dominica, small local type, 48.0 per cent. oil.

Antigua, mixed large types, 54.4 per cent. oil.

The castor seed plant commences to bear in three or four months after planting and will continue to do so for at least three months. In the tropics, the plant is a perennial, often growing to 30 or more feet in height but under cultivation it is not advisable to continue growing after six months as the plant then becomes liable to be attacked by scale insects and the yield is considerably diminished. Cut worms may also be a considerable nuisance.

Castor seed is an exhausting crop and rotation should be practised. Castor seed, ground nuts and sweet potatoes form a suitable rotation.

When the capsules turn brown it is time to harvest the seed; this is done by cutting off the spikes and removing them to a barn to dry. Capsules left to dry on the tree are apt to burst open and scatter the seeds.

Numerous methods are adopted for removing the woody capsule from simple hand shelling to the use of elaborate and efficient machines. The Cardwell Machine Co. of Richmond, Virginia, quote a sheller dealing with 60 to 90 lbs. seed per hour at £37 1/8 and Messrs. Miller Brothers, Royal Liver Building, Liverpool, manufacture a small hand centrifugal machine for cracking palm kernels which might prove suitable for castor seed, the price of £4 10/–.

Two main methods exist for preparation of the oil. The crude method consists in crushing the seed in a mortar and stirring in boiling water until the oil rises to the surface from which it is removed by skimming.

In the modern process the uncrushed seeds are pressed cold to obtain the highest grade oil, the residual cake being heated and repressed to obtain a further quantity of lower grade oil. The oil as it flows from the press is a whitish liquid containing starch, albumin and mucilage which are subsequently separated by clarifying and refining by suitable treatment with fuller's earth and filter-cel.

Small scale attempts to grow castor seed as a crop have been made from time to time in this colony. The reports of the Antigua Agricultural Department for the years 1911-12, 1912-13, and 1913-14 show the results obtained on plots at the experiment station, while the St. Kitts-Nevis report for 1917 records the results of experiments in Nevis during that year.

In the main results point to a yield of half a ton per acre, but weather conditions were adverse. Recent experiments in Antigua point to a closer planting of 4' x 4' as being more favourable.

The following yields obtaining in other parts of the world may also be of interest:

India (Madras district): 200-700 lb. per acre, depending on the land and rainfall.

Malay States: 800 to 1,200 lb. per acre.

Argentine: 900lb. per acre.

St. Vincent: 1,000 lb. per acre.

As a general rule the conditions of soil and of climate suitable for cotton are well adapted for the castor plant which should therefore thrive in parts of the Leeward Islands. The plant flourishes in light rich, well-drained loams and will not do well on heavy, wet soils or ill-drained swampy lands.

The market for castor seed and castor oil would appear to be practically unlimited, the consumption depending entirely on the supply of seed. The principal producers are India, Japan, Java, China, Brazil and the United States of America.

The following list indicates some of the many uses of castor oil: medicinally, as an illuminant, as a lubricant, in the manufacture of soap and candles, in leather dressing and in the manufacture of fly papers and of turkey red oil. Castor pomace the residue obtained after the the expression of the oil, is a valuable nitrogenous manure.

The following figures for the imports of castor seed and oil into the United Kingdom and of castor seed into the United States during the years 1921 and 1922 give some idea of the volume of trade in castor products.:

Imports Into The United Kingdom.

1921, 13,033 tons seeds, value £217,450; Oil, 510 tons, value £28,370.

1922, 18,438 tons seeds, value £305,437; Oil 2,515 tons, value £12,243.

Value of seed per ton: 1921, £16 14/; 1922, £16 12/.

Value of oil per ton: 1921, £55 10/; 1922, £48 10/.

Imports Into United States of America.

Weight of seeds, 1921: 36,565,000 pounds; 1922, 81,673,345 pounds.

Value, 1921, $906,857 1922: $2,409,385.

Value per English ton: 1921: $53.55; 1922: $66.08.

Value in 1923: $101.86 or £22 per ton.

At the present time the New York market is stated to be better than the London market and the freight rates are somewhat lower.

From advices received it would appear that as far as the United States is concerned it would be more profitable to export castor seeds on which the duty is ½c. per lb. than castor oil on which there is a high import duty.

The whole question of success or failure of castor seed as a crop in this colony depends on the yields obtained. Until large scale experiments have been carried out it will be impossible to make a definite

statement. Such experiments are now being undertaken especially in Nevis, Montserrat and Anguilla.

D. Ground Nuts.—The name ground nut is due to the fact that after fertilization the flower stalk bends downwards and enters the ground so that the fruit develops in the soil.

Ground nuts are best grown on light, sandy and loamy soils; light volcanic soils seem particularly suitable for their cultivation.

An application of lime to the soil two months before planting is very beneficial and the use of well-rotted pen manure some time before sowing is desirable. Acid phosphates and potash fertilizers may also be used.

In the preparation of the soil, tilling should be thorough so that the soil may be light enough for the flower stalks to enter it easily. The nuts may be planted on the level or on small banks about 6 inches high.

The pods should be shelled immediately before sowing and all unsound or dark nuts should be rejected. The seeds are planted in rows 3 to 4 feet apart and 18 to 20 inches apart in the rows. At a spacing of 3 feet by $1\frac{1}{2}$ feet, 19,000 seeds are required per acre. Germination takes place in 8 to 10 days.

The only cultivation necessary consists in keeping the land between the young plants weeded and of a loose texture. In weeding care must be taken not to injure those flower stalks which have already bent over and become fixed in the soil.

The nuts are ready for harvesting in from $4\frac{1}{2}$ to 6 months from the time of planting and it is desirable that harvesting should take place during a dry season. The plants are generally lifted by a fork and the soil shaken off: they are then allowed to lie on the ground in the sun for some days to cure. The nuts are then picked by hand or by a picking machine.

The vines may be used as fodder or may be ploughed under as green dressing. The suitability of ground nuts as a rotation crop with castor seed has already been stated.

When nuts are being marketed for eating purposes it has been found advisable to wash before sun drying in order to improve their appearance Bleaching is also practised. When nuts are grown for oil production these precautions are unnecessary.

The actual yield of nuts per acre varies considerably, 1,000 to 1,500 lb. being the average, but under favourable conditions the yield may exceed 3,000 lb.

Apart from local requirements the market for ground nuts is considerable, the imports into the United Kingdom alone in 1922 amounted to 65,756 tons valued at £1,167,746—the average price being £17 15 - per ton.

In the Leeward Islands ground nuts have already been grown with fair success in Barbuda, Montserrat and the Virgin Islands.

Spices.

A. Vanilla—Two species of vanilla are cultivated—*Vanilla planifolia* —the true Mexican vanilla, and *Vanilla pompona*—native West Indian vanilla. The former bears the more fragrant pods and is the more profitable as a crop.

Vanilla has been grown on a small scale both in Nevis and in Dominica. In the latter island there is considerable room for exapansion of this industry as in many districts both climatic and soil conditions are

suitable. A hot moist climate is required with frequent but not excessive rains: dryness and strong direct sea winds are fatal. The best vanilla soils are light friable soils rich in humus and plantations are best situated on sloping hillsides.

Vanilla is a crop well situated to small cultivators as little capital is required for its production and its growth does not require much attention. The flowers will not set fruit, however, unless hand fertilized; this operation requires some small amount of skill but can easily be learned. The curing of the beans is a somewhat more formidable process, as care and skill are needed and there must be some outlay of money for the construction of proper curing houses.

At the present time there exists in Dominica a local demand for uncured beans—the purchasers being certain planters possessed of proper curing equipment. It should be possible to increase the curing facilities to meet a larger porduction of beans, and it might be desirable to form an association for the purchase preparation and marketing of vanilla.

Recently vines on certain Dominica estates have been attacked by a fungus; if, however, new cultivation is carried out with sound material obtained from healthy and unaffected districts, this should not seriously affect the growth of the industry.

The following table shows a comparison between the exports of vanilla from Dominica during the period 1919-1920 with those from the neighbouring island of Guadeloupe during the same period:

	Dominica.	Guadeloupe.
1919 ..	2,444 lb.	57.447 lb.
1920 ..	1,316 lb.	35.000 lb.

At the present time, a fair price is obtainable for high class vanilla. In May, 1923, the price of Mexicans in the New York market was $11 to $15 per lb. Dominica vanilla is of the same type as Mexican.

B. Ginger. (*Zingiber officinale*)—The ginger plant is cultivated both in tropical and in sub-tropical regions, the chief sources being Jamaica, China, India, Japan and West Africa. It requires brilliant sunshine as well as a heavy rainfall, 90 to 100 inches. A fairly moist yet well-drained soil rich in humus and easily worked is most suitable for this crop. These conditions both of soil and of climate are fulfilled in many districts of Dominica but not in other portions of the Leeward Islands.

At the present time a certain amount of ginger is grown in Dominica for local consumption, but the exports of this product are negligible and owing to poor methods of preparation, the prices obtained are not remunerative. The cultivation is almost entirely in the hands of peasants, who grow this crop for their own use and who in most cases are ignorant of, and unwilling to, undertake the necessary preparation for export. In a report by Mr. J. Jones, the Agricultural Superintendent, he has emphasised the fact that while the conditions for ginger growing in Dominica are excellent a successful export trade in that commodity will depend on the forming of an association to purchase the green ginger and prepare it for export.

Ginger usually appears on the market in two forms, dried or cured ginger and preserved ginger. In Jamaica, India and Africa, the spice is invariably prepared as cured ginger, while in China preserved ginger is also made. This is prepared from a distinct variety, the rhizomes of which are thicker and more succulent.

Dried ginger is prepared in two forms, black or coated ginger and uncoated or white ginger. The latter is considered the better product and is sold at a much higher price.

The first stage in the preparation of white ginger is the peeling of the rhizomes. They are freed from earth and roots by unskilled labour, but the peeling process requires some care and skill. The most skilful peelers peel between the toes, which are often carefully rounded to give the hands a better appearance The sides of the rhizomes are peeled by children or less experienced persons.

After peeling, the hands a'e thrown into water and washed thoroughly; the purer the water and the more used the whiter the cured ginger.

Drying is carried out by exposing the wet hands to the sun—preferably on palm leaf mats which allow a circulation of air between the pieces. The rhizomes are spread out at sunrise, turned at mid-day and placed under shelter at sundown. They must also be sheltered should rain fall during the six or eight days required for drying, as drying ginger if wetted is liable to develop mould. As will be seen from the above process, drying ginger in wet weather is a difficult undertaking.

Various processes exist for whitening uncoated ginger. The dried product is sometimes treated with diluted lime juice and then dried again. It is said that the difference between ginger treated in this way and ordinary dried ginger is very apparent.

Ginger is also bleached by immersion in bleaching powder solution or by exposure to the action of sulphur dioxide. It is also sometimes coated with calcium carbonate or calcium sulphate, eg., Japanese ginger. This coating rubs off readily, however, and is easily detected.

The cured product must be carefully sorted and graded before placing on the market. The importance of careful grading can hardly be overestimated. One season Jamaica ginger although of a better quality than the Cochin ginger on the market, sold at a somewhat lower price simply because it was not carefully graded. Buyers prefer to pay high prices for an article the quality of which is uniform and on which they can depend.

In certain of the ginger-growing districts of Dominica sun drying would be well nigh impossible. Sun drying would be feasible in Roseau or other dry localities on the Leeward coast, and as the rhizomes need not be peeled for some days after digging, transportation to a curing grading and packing station on the coast would be practicable.

The importance of producing a carefully graded high class article is indicated by the following quotations for ginger in the New York market in May, 1923:

Africans, $13\frac{3}{4}$ to 14 cts. per lb.
Japanese, 14 to $14\frac{1}{2}$ cts. per lb.
Cochin, 15 to $15\frac{1}{2}$ cts. per lb.
Jamaica Fancy Bold, 42 to 43 cts. per lb.
Jamaica medium dark, 35 to 36 cts. per lb.
Jamaica dark grinding, 32 to 33 cts. per lb.

The cost of preparing land for ginger and of keeping the fields free from weeds until the rhizomes are ripe, and of the preparation for the market are considerable. In Jamaica, the average yield per acre varies from 1,500 to 2,000 lb. dried ginger. At 30 cents per lb. the lower figure would give a gross return of $450 per acre. This should allow a considerable excess over the expenses. On the other hand, it must be remembered that the market for ginger is not unlimited and any considerable expansion of the world's existing production would result in lower prices. The imports of ginger into the United Kingdom in 1922 were 38,835 cwts. valued at £128,385.

C. Nutmegs and Mace.—Both these spices which are obtained from the East Asian nutmeg tree (*Myristica moschata*) are produced chiefly in Ceylon, the Moluccas, Penang, Grenada and Trinidad. As a rule, really successful plantations of nutmegs are not found at any distance from the sea so that the cultivation of this plant is largely confined to islands.

The temperature range varies from 76 degrees to 92 degrees F. and the optimum rainfall is in the region of 90 to 100 inches per year, well distributed.

As regards soil—this tree appears to thrive on a variety of soils. In the Banda spice islands, the nutmeg tree grows on a light volcanic soil rich in humus. In Penang, the crop is grown on a rather friable yellow loamy clay, while in Trinidad, virgin forest with rich soil is preferred. Wet or flooded ground is fatal so too is excessively dry ground.

Seeds of the nutmeg have poor keeping qualities and should be planted soon as after gathering preferably in well manured soil in shaded nurseries.

The young nutmeg trees are usually planted at a distance of 26 to 30 feet apart; the holes for planting should be about 4 feet wide and at least 3 feet deep and should be filled with a mixture of leaf mould, burnt earth and well-rotted manure.

In hot places it is desirable to shade the young plants until they have taken root—which should take place in 10 to 14 days. The time for planting should be at the beginning of the rainy season in any district where the seasons are distinct.

The nutmeg tree is comparatively small being 30 to 40 feet high, and is frequently grown under the shade of larger trees—in Trinidad the Jamaica shade tree (*Pithecolobium saman*) has been advocated for this purpose.

The space between the nutmeg trees should be kept comparatively free from weeds and climbers should be removed. Mulching is desirable.

The nutmeg tree is normally monoecious and unfortunately it usually takes about seven years for the plant to flower and thus discover its sex. Most of the male trees are destroyed as soon as their sex is determined, one male to 8 or 10 females being sufficient for fertilization.

As a rule the trees commence to fruit in the eighth or ninth year and continue to bear for over 60 years. In Grenada, it takes about 12 years before a tree starts to pay and 14 years before there is much profit.

The fruit is a drupe, the pericarp of which opens by splitting almost into two halves when ripe. Within the husk is the seed, the nutmeg of commerce enclosed in a brown seed coat which is covered by a crimson net-work, the mace, which is an arillus or outgrowth from the base of the seed.

The mace is removed from the seeds and is flattened between two boards and is then dried in the sun for 4 to 5 hours each day for a fortnight or until dry. After drying it is packed in casks.

In the preparation of the nutmeg the seed is dried and the testa removed. Drying may be effected by exposure to the sun or by artificial heat. The removal of the testa is frequently carried out by a machine invented by Mr. John Rudder of Barbados in 1902, which is said to be capable of cracking one barrelful of nuts in two minutes.

Nutmegs are valued according to size and for a successful export trade in this article careful grading is essential. The graded nutmegs are packed in casks or in chests which have been made air and water tight by sealing all cracks with resin.

The following prices were current in March, 1923, in the United States markets:

Mace:

Banda, 46 to 47 cents per lb.

Batavia, No. 2, 40 to 42 cents per lb.

Penang, No. 2, 42 to 45 cents per lb.

Nutmegs: 110s., 24 to 25 cents per lb.

80s. 27 to 27½ cents per lb.

A Ceylon estimate fixes the average yield at about 750 lb. nutmegs and 120 lb. mace per acre. At the above prices the value of the produce of one acre would be about

Mace, $30.000

Nutmegs, $300.00; total $350.00, roughly £68 15/.

As will be seen by reference to the remarks re climate and soil, certain portions of Dominica are well suited to this crop and indeed nutmeg trees are known to flourish in this Island. So far, however, little success has been met with in their cultivation and the export has been negligible.

For comparison the exports of nutmegs and mace from Dominica and from Grenada for the period 1919 to 1921 are quoted below:

	Dominica.	Grenada.
1919 ..	£18	£73,232
1920 ..	7	49,215
1921 ..	96	60,792

The lack of success in Dominica has probably been due to the absence of grading and to shipping the nuts unshelled.

Fruits and Vegetables.

The possibility of developing a fruit and vegetable industry in the colony merits some consideration—especially in Dominica and to a lesser extent in Montserrat.

In Dominica, a small export trade in fruit exists chiefly with the neighbouring French islands and with Bermuda. The exports of fruit during 1921 and 1922 were as follows:

Bananas, 1921, 2,944 bunches, value £221; 1922. 3,381 bunches, value £254.

Mangoes: 1921, value £1,036; 1922, 7,880 crates, value £1,576.

Oranges, 1921: 1,294 barrels, value £776; 1922, 1,564 barrels, value £939.

Avocados and grapefruit, 1921: value £268; 1922, value £450.

Total 1921, £2,301; 1922, £3,227.

In Montserrat a Fruit and Vegetable Growers Co-operative Association has recently been formed but so far exports have been only on a small scale.

The possible expansion of the Dominica fruit industry has been dealt with at some length by Mr. J. Jones in his 1921-22 report. It is pointed out that a profitable export trade in mangoes and avocados might be developed but that a considerable extension of the areas under these fruit would be necessary and that several years would elapse before the new trees bore fruit in quantity. At the present time the export trade in mangoes is confined to seedling mangoes of little merit, but it is known that the "Julie" can be placed on the New York or Canadian market in first class condition. Unfortunately sufficient trees of this variety do not yet exist to supply even the local demand.

Recently the question of growing bananas on the large scale has been discussed and a committee of the Dominica Agricultural Society has

been appointed to consider a scheme for producing 5,000 bunches of bananas per month. It is hoped that the United Fruit Company who have agreed to ship bananas from Grenada, may be induced to make a similar arrangement in the case of Dominica.

Unfortunately, a case of Panama Disease has recently been reported at Morne Bruce but it is hoped that owing to the isolated position of this case it may be possible to check any spread of infection.

Pineapples are grown on a small scale in most parts of the colony: in Antigua at one time this crop was the chief minor industry. Owing, however, to the poor shipping qualities of the native Antigua pines and to the prevalence of heart rot the industry gradually decayed.

At the present time a small pineapple industry might be profitable if good shipping varieties, such as the Red Spanish are grown, and if sufficient care is taken in grading, and packing the fruit for export. It might be advisable to ship only the larger sizes and to can the smaller fruit.

In Antigua, there has been some revival of interest in pineapples and a pineapple growers' association has been formed. In Montserrat, the Fruit and Vegetable Growers' Association have started growing this crop on a small scale, while in Dominica several acres have been planted.

As regards vegetables, onions are already grown on a fair scale in most parts of the colony at a fair profit; it might also prove profitable to grow tomatoes and cabbages.

The chief drawback met with in the onion industry is the difficulty of getting the crop on the market early enough to secure top prices. The onion as a rule will not set seed in the West Indies and it is usual to import seed from Teneriffe. As a rule, this arrives rather too late to allow the onions to reach the best winter market. A possible solution of the difficulty may be reached through some method of keeping the seed from one year to another. Storage at a low temperature over quick lime or some other dessicating agent would not be likely to injure the germinating power.

Experiments on growing tomatoes for the Canadian winter market were conducted in Antigua in 1913-1914. Unfortunately, the first shipment which would have arrived in St. John in January was lost by shipwreck. A subsequent shipment was made in May arrived in good condition and fetched 4d. per lb. although competing with early hot house fruit.

The Montserrat Fruit and Vegetable Growers' Association have made a few shipments of tomatoes but they are not yet in a position to state whether or not the project will pay.

In conclusion, it may be mentioned that a profitable vegetable industry exists in the Virgin Islands, the produce being marketed in St. Thomas.

Papain.

Commercial papain is the dried latex of the fruit of *Carica papaya* It is largely used as an aid to digestion in virtue of the proteolytic ferment contained therein.

At the present time the demand is in excess of the supply which is obtained chiefly from Ceylon with small quantities also from Montserrat. The United States of America is the largest consumer importing annually to the value of £15,000 to £16,000.

Carica papaya is a distinctly tropical plant; specimens grown out of the tropics seldom bear fruit. The plant is best grown below an elevation of 1,200 feet. Once established the trees are capable of enduring a

wide range of moisture variations in the soil; but under water-logged conditions they suffer

For the preparation of papain the latex is collected by making slight incisions not more than one-eight inch deep in well-grown unripe fruit and allowing the resulting milk to run into enamelled or earthenware vessels. Iron and steel should not come in contact with the latex as they discolour it—a sharp piece of glass or a knife made out of a thin shaving of bamboo may be used for incising the fruit.

After collection the latex is treated with water, which instead of diluting it causes it to curdle. The coagulated mass is squeezed in a cloth to remove some of the superfluous moisture and the residue is either spread in a thin layer and sun dried or is dried in an oven at 100 degrees to 120 degrees F., the rate of drying being hastened by the passage of a current of air.

It has been found in India that in the preparation of crude papain, the following points are of importance as influencing the activity of the product:

(1) Dry as quickly as possible—below 40 degrees C.

(2) Complete the drying process in vacuo.

(3) Grind the dried product and ship in sealed bottles or in lead-lined wooden boxes.

The papain industry has been in existence in Montserrat since 1891, but during the past 11 years there has been a gradual decline owing to the superior attractions of cotton.

Recently, however, a few large planters have turned their attention to this industry on systematic lines, and it is to be hoped that there will be a recrudescence of the industry in the near future.

The climatic conditions as indicated above are such that would allow the cultivation of this crop in most of the islands of the colony, and in view of its admittedly profitable nature under Montserrat conditions, the extension of the industry can be recommended.

In conclusion it may be stated that the price paid to peasants in Montserrat for wet milk over the past few years has been 1/6 per lb. and this figure has been found profitable.

The market value of papain varies from 7/6 to 15/- per lb. depending on the activity of the product. With a return of one lb. of dried papain per 4.4 lb. milk as obtained from one type at the Montserrat Experiment Station there would appear to be a very fair margin of profit when a high class product is put on the market.

Tobacco.

The tobacco industry appears to have been well established in St. Kitts in the 17th century, but owing to the fact that considerable care and skill are required in the preparation of the crop it was abandoned in favour of sugar and cotton.

In more recent times—an attempt was made to establish a tobacco industry in Antigua and for some time Antigua tobacco was sold locally. Shipments to the United Kingdom, however, were not found to be suitable for that market.

In 1902, experiments in tobacco-growing were conducted at the Antigua Botanic Station but before any tangible results were obtained work in connection with the promising young cotton industry caused their abandonment.

In St. Kitts the growing of Sumatra and Havana tobacco was started in 1901 at the Botanic Station and on four estates. The field results

were satisfactory but the drying and curing operations were not, owing to lack of proper knowledge of the processes.

Experiments were, however, carried on the small scale until 1907. These showed that good tobacco could be grown in St. Kitts, as much as 170 lb. of cured leaf being obtained from one-fifth acre, but that while this tobacco found a ready market locally it was not up to the requirements of the English market. This was probably due to the fact that the quantity grown was at no time sufficient to allow of a proper fermentation.

Owing to the superior attractions of Sea Island cotton, the St. Kitts planters evinced little interest in tobacco, and no further progress was made.

During the last two years interest has again been aroused in tobacco and in St. Kitts and the Virgin Islands large scale experiments have been inaugurated. Small scale experiments have been conducted in Antigua and Dominica.

In the Virgin Islands the curing and fermentation of the leaf are under the direction of the Curator who spent some time in Porto Rico during 1922 to study these processes. In St Kitts the preparation of the leaf is in the hands of a tobacco expert engaged in Jamaica for the St. Kitts Government In both presidencies promising results have been obtained. Cigars of fair quality are being produced in the Virgin Islands—over 6,500 being sold during September, while in October a shipment of two bales pipe tobacco has been made to a London firm.

In St. Kitts there are already four acres under tobacco at La Guerite Experiment Station and arrangements have been made for planting another four. Cigars are being produced and cigarette making machines are being procured.

Similarly, five acres have been planted in this crop in Dominica, and arrangements are being made for curing it as pipe tobacco.

The successful establishment of a tobacco indus ry in the Leeward Islands depends to a very great extent on the care taken in the preparation of the leaf—curing and especially fermentation. The importance of proper fermentation can hardly be exaggerated. It has been found in England –in Hampshire –that the quality of tobacco can be so improved if this process is carried out in the proper way that its value can be raised from a nominal 1/ to 1/3 per lb. to 3/ and 4/ per lb.

It would be inadvisable for individual planters to attempt the fermentation of their own leaves, unless they are in a position to grow tobacco on a large scale and to obtain expert assistance. In most tobacco-growing districts while it is customary for the farmer to cure his produce, the cured leaves are generally fermented in tobacco warehouses.

Tobacco leaves are generally divided into three classes at the time of harvesting—middle leaves, top leaves and sand leaves. As these three classes should be fermented separately in piles of from 2,100 to 8,000 lb. it will be realised that for proper fermentation a considerable quantity of leaf is required

Raisin Grapes.

Raisins are three main types—(1) large raisins made principally from the Muscat or Alexandria grape (2) medium sized, light coloured seedless raisins, made principally from the Sultanina grape and known as Sultanas: (3) small dark seedless raisins made principally from the Black Corinth and known as currants.

The Muscat grape is grown to a small extent in the West Indies and flourishes under the prevailing climatic conditions. Seedless raisin grapes have not so far been grown in these islands. In the raisin growing districts of California where they are cultivated on a large scale the summer temperature is about 85 degrees F. in the shade during the day, although it is considerably lower at night. The summers are dry, and in some districts, where the total annual precipitation is only 13 inches, irrigation is necessary.

The climatic conditions in many parts of the colony would be suitable for grape growing especially in Montserrat and St. Kitts-Nevis. In both these presidencies grapes should do well on the light volcanic soils especially in situations near the sea below 1,200 feet and having a southeast aspect.

It must be remembered that in the south of Europe and in California there is a distinct winter each year during which the vines are dormant. Under West Indian conditions there would be two or more crops each year, the growing seasons being separated only by an ill-defined dormant period. This would tend to exhaust the vines and thus shorten their lives and decrease their total productivity.

The market for raisins and currants is considerable as may be judged by the quantities imported into the United Kingdom alone during 1921 and 1922.

	RAISINS.			
	Quantity.	Value.	Value per cwt.	Value per lb.
1921	728,147 cwt.	£3,671,447	£5	10/6
1922	1,183,823 cwt.	£5,088,095	4 6 0	9/2
	CURRANTS.			
	Quantity	Value.	Value per cwt.	Value per lb.
1921	1,007,756 cwt.	£3,218,381	£3 4 0	5/9
1922	1,035,386 cwt.	£3,368,576	£3 5 0	7/0

As will be seen the prices obtainable are attractive, but mention must be made of the fact that the production of raisins is extending enormously in Australia, so that lower prices may be expected in the future.

The question of establishing a small raisin grape industry in the colony is, however, well worth consideration provided always that it be realised from the start that the culture of grapes requires considerable skill and attention if profitable results are to be obtained.

Bay Oil Industry.

A bay oil industry already exists in both Dominica and Montserrat. The exports during the last three years are given below.

1920: Montserrat, 470 lb; 1921: 2,850 lb.

1920: Dominica 2,356 lbs; 1921: 2,432 lbs; 1922: 3,000 lbs.

At the present time expansion of the industry is hindered by the limited market for the oil and the low prices realised. The question of manufacturing bay rum in the colony has been given some consideration, investigations have been conducted both by the Imperial and the Federal Agricultural Departments and advice has been given to planters interested in the matter. So far, however, little progress has been made, although it has been demonstrated that a good quality of bay rum can be made.

St. Thomas Bay Rum is sold wholesale at 3/ per gallon, and any other bay rum to be sold in the same markets must be able to compete in price with this article. The chief markets for bay rum are the West Indies and the countries of South America. In the case of the British

West Indies there is a preferential tariff on British made bay rum which would assist the bay rum made in the Leeward Islands.

At the present time a white rum can be obtained from British Guiana at 2/4 per proof gallon. Even if bay rum is manufactured in bond from this article and exported free of export duty there is only a small margin of profit when consideration is given to the cost of the oil used and labour and other expenses involved in manufacture.

The retail price of bay rum in the colony at 2/4 to 2/6 per quart, i.e., 14/ to 15/ per wine gallon allows of a considerable profit to the retailer. This is particularly so in Montserrat where the duty on bay rum is only 1/1 per gallon, and less so in Dominica where it is 6/ per gallon. An import duty of 6/ per gallon on foreign bay rum thoughout the colony with a preferential duty of 2/ or 3/ on locally made bay rum might permit a small but profitable inter-presidential trade in this article.

Instead of using imported rum for the manufacture of bay rum it would be possible to use locally made rum in some parts of the colony, e.g., in Dominica. In St. Lucia a small bay rum industry exists in which St. Lucia rum is used. It must be remembered, however, that if a high class bay rum is produced the ordinary rum must be converted into silent spirit, which is free from esters and does not impart an unpleasant flavour to the resulting bay rum.

"THE EXTENSION OF CERTAIN CITRUS BY-PRODUCTS (WITH PARTICULAR REFERENCE TO THE CITRUS INDUSTRY IN DOMINICA.")

By

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(Communicated by the Hon. R. Nosworthy.)

At the present time the Dominica Citrus Industry is chiefly a by-products industry since the export of citrus fruit is small compared with that of raw and concentrated lime juice and of citrate of lime. There still exists, however, the possibility of modifications in the methods of manufacture of the products now marketed and also of further developments leading to the fuller use of all parts of the fruit. In this connection, it should be noted that in California, where considerable attention has been given during recent years to the development of a by-products industry from cull citrus fruit, it is realised that the successful operation of such an industry depends on the complete utilization of the fruit.

The present paper contains a brief review of the existing conditions of citrus by-products in Dominica, together with suggestions for possible new developments based both on investigations carried out at the Federal Laboratory for the Leeward Islands, and on processes used in the United States of America and in Sicily.

As regards the application of American and Sicilian processes in Dominica, the fact that the lime predominates enormously among the citrus fruit of that island may necessitate certain modifications of processes devised for oranges and lemons. In certain parts of Dominica, however, oranges and grape fruit are grown on the large scale.

FRUIT JUICES.

A. Raw Juice. A considerable export trade in lime juice already exists in Dominica, the exports of this article in 1921 and 1922 being 112,317 gallons and 286,782 gallons, respectively. It is probable that a considerable increase in this trade would follow the solution of two problems: the clarification of the raw juice without injury to its flavour and the preservation of the clarified juice.

Raw lime juice as first expressed is a milky pale greenish white liquid which is difficult to filter and when filtered yields a still turbid filtrate.

It is customary to effect clarification by allowing the juice to settle for some time in large vats, where a separation into three layers takes place. At the bottom of the vat, a layer of sediment forms and on the surface, a layer of scum consisting of pulp impregnated with the essential oil which is expressed with the juice during the crushing of the limes. The middle layer is a clear yellow liquid which has to some extent the flavour of fresh juice.

Attempts at hastening the clarification process by agitating in the cold with fullers earth or such a diatomaceous earth as filter-cel are only partly successful and require rather large quantities of the clarifying agent.

Effective clarification can be accomplished by heating the juice with 1—2% by weight of its volume of filter-cel and subsequent filtration, such a product, however, lacks the flavour of raw juice and possesses instead an unpleasant "cooked" taste.

Unsettled raw lime has fair keeping qualities and the juice settled in vats as already described undergoes little change as long as it remains there. On removal of the clear juice, two changes take place, one a destruction of citric acid by moulds, the other a slow darkening until an almost black colour is reached.

The good keeping qualities of unsettled juice and of juice stored in vats and covered with a layer of pulp and oil are due partly to the antiseptic action of the essential oil and partly to the exclusion of air by the scum which thus renders conditions unfavourable to the development of the aerobic acid—destroying organisms. At the same time, the exclusion of air prevents the oxidation and consequent darkening of certain constituents of the juice.

The loss of citric acid during storage of unsettled raw juice has been investigated in Dominica by G .A. Jones (1) and by S. M. Davis (2).

Jones has found that juice from sound ripe fruit may be stored in open vessels for two months with a loss of only 2.2% of the total acid present but that in the case of lower grade juice, the loss during that period was 71%. Davis working with second roller juice fresh from the mill found the loss of citric acid per week was about 5% of the total present. He considered, however, that in large storage tanks with large volumes of juice covered with a thick scum this loss would be reduced.

Recently experiments have been conducted at the Federal Laboratory with isinglass as a clarifying agent for cold raw juice, but the results so far have not been very encouraging. Acid potassium sulphite has also been tried as a preservative; but in concentrations high enough to preserve clarified juice from moulds and from darkening it imparts an unpleasant smell of sulphur dioxide.

Attempts have been made in the United States of America both in California (3) and in Florida (4) to preserve orange and lemon juices. Complete success has not been attained, although pasteurisation at 63-65 Centigrade for fifteen minutes followed by sealing in vacuo gave a product which remained free from mould growth and retained its colour.

Clarification was found a serious problem, but a somewhat clear though still opalescent liquid was obtained by the use of de Laval clarifiers. An alternative process was a settling one similar to that practised in Dominica save that the juice was pasteurised out of contact with air before allowing to settle.

Unfortunately, limited equipment has prevented the trial of a de Laval separator with Dominica raw lime juice, but there seems no obvious reason why the same clarification should not result as with orange or lemon juice.

B. Vinegar. Before passing on to concentrated juice mention should be made of the possibility of the product on of vinegar from orange juice. On the Imperial Road many of the Oranges grown remain unused, or are only used for the production of orange oil, and might be converted with profit into this product.

Directions for the manufacture of orange vinegar are given at some length in Department Circular 232 (5) of the United States Department of Agriculture. An attempt has been made to carry out this process at the Government Laboratory but no fermentation was obtained; this appears to have been due to the presence of essential oil in the juice. It is therefore proposed to repeat the attempt with juice clarified by heat from which the oil has thus been expelled.

C. Concentrated Juice. The export of concentrated lime juice from Dominica is considerable: the figures for the period 1919-1922 are as follows:—

1919.	1920.	1921.	1922.
166,718 gallons.	154,040 gallons.	227,716 gallons.	162,222 gallons

At the present time, all the larger plants concentrate by steam heat, although on some of the smaller estates the old method of concentration over open fires still exists. The losses of citric acid in the two processes are about 3% for the steam process and 10-20% for the open fire process, depending on the care taken. In addition to this, juice concentrated by steam is cleaner and more free from sediment, and is said to find a market for direct use in calico printing without a preliminary conversion into citric acid, which is necessary with the lower grades.

The author has carried out experiments on concentration under reduced pressure and has found that when a juice clarified by heating with filter cel is used, an amber coloured product containing 97 ounces citric acid per gallon can be made without any loss of acidity during concentration. On standing, however, this light coloured juice slowly assumes the dark brown colour of ordinary concentrated juice. No doubt sealing in vacuo would inhibit oxidation and stop the colour change; this would hardly be practicable however, in the case of a product packed in large containers.

In certain experiments, the juice was treated with a decolourising carbon before concentration but the final colour was not much lighter than when the decolouriser was not used.

Recently a planter in Dominica has been in treaty with an engineering firm in the United Kingdom for the erection of a multiplex evaporator for lime juice concentration. Should this project materialise, it is probable that a high grade juice will be produced with the minimum loss of citric acid and at a low consumption of fuel.

Citric Acid and Calcium Citrate.

A factory for the manufacture of Citric Acid was erected by Messrs. L. Rose & Company at the Bath Estate, Dominica, in 1921 and a

shipment of 2 cwt. acid was made that year while in 1922, 35 cwt was exported.

About the same time a scheme for a second citric acid factory was discussed, but owing to the fall in the price of the acid no further steps have been taken in this direction.

The shipments of citrate from Dominica vary considerably from year to year, depending not only on the crop but also on the relative values at the time, of citrate and concentrated juice. The amounts exported in 1921 and 1922 were 10,328 cwt. and 6,450 cwt., respectively.

A full description of the process used in the manufacture of citric acid from lemons at the factory of the Exchange By-products Company in California has been published in the Journal of Industrial and Engineering Chemis ry, June, 1921, (6) and an article on the manufacture of Calcium Citrate and Citric Acid appeared in the Agricultural News (7) o' September 17th and October 1st of the same year.

At the present time an investigation is being conducted by the author, in collaboration with Professor Hardy of the Imperial College of Tropical Agriculture, with a view to improving the existing processes for the manufacture of citrate and citric acid. Under present conditions it is found necessary to decolourise the citric liquors by treatment with an absorbent carbon before the final crystallisation of the acid. This is due to the fact that certain constituents of the juice, which darken on oxidation are retained in the calcium citrate and so pass into the citric liquors, which are obtained on treatment of the citrate with an equivalent quantity of diluted Sulphuric Acid. While it is not possible to quote details at the present time, it has been found that by taking great care in the neutralisation of the juice not to have an excess of lime or chalk and by thorough washing of the wet citrate, a product can be made which retains so little of the chromogenic constituents of the juice as to give a practically colourless citric acid, without the use of a decolourising agent. There is a rather higher loss of acid than is the case in the ordinary process, but as there is a reduced consumption of lime and of Sulphuric Acid and as carbon is not required it is possible that the modified process may be the more economical of the two.

It has been found that a very large proportion of the colour producing constituents of lime juice are absent from the juice as it exists in the fruit, but as they are present in the peel they find their way into the juice during the crushing of the limes. It therefore seems probable that the juice of peeled fruit would yield a citrate from which a colourless citric acid could be made without the use of decolourising carbon, and indeed on a small scale experiment with hand peeled limes this has been realised. Machines have been used in the United States of America for peeling larger citrus fruit such as oranges, and it is possible that they might be applicable to limes also, although the irregularity in size of the latter might hinder such a perfect peeling as would be desirable for the exclusion of the colouring agent from the juice.

The question of the direct manufacture of Citric Acid from lime or lemon juice has long been an unsolved problem. Lime and Lemon juices contain in addition to citric acid other organic acids in small proportions together with sugar, gums, pectins, proteins, polyphenols and inorganic salts. It has been generally accepted that the inability to produce citric acid crystals by direct evaporation of these juices is due to the presence of such colloidal constituents as pectins, gums and proteins. With this idea experiments have been conducted in the Federal Government Laboratory in which juice treated with filter-cell

and absorbent carbon, and also dialysed juice have been evaporated. In some cases small yields of crystals were obtained, but these were very small in size and it was found almost impossible to separate them from the sticky mother liquors.

Recently Poore has investigated the effect of dialysis on the direct crystallisation of Citric acid from lemon juice, and has concluded that the small quantity of colloids (pectin, gum, protein) in the juice does not affect crystallisation, but that the ash and other non-acid constituents do so.

Peratoner and Scarlata are credited with having devised a method of manufacture in which many of the non-acid constituents are precipitated by a mixture of alcohol and ether. Such a process would not be economically possible in the tropics, where the recovery of a volatile solvent like ether would be well nigh impossible.

Essential Oils.

The exports of citrus oils from Dominica in 1921 and 1922 were:—

	1921	1922
Distilled lime oil.	51,524 lb.	76,150 lb.
Ecuelled lime oil.	18,55 lb.	24,267 lb.
Orange oil.	844 lb.	1,867 lb.

Ecuelled oil is produced in Dominica chiefly by the hand ecuelle pan although an ecuelling machine invented by Allport and Davenport is also used to some extent. One of the drawbacks to the more extensive use of this machine i the comparatively large residue of emulsified oil which is produced. It has been found at the Federal Government Laboratory that filtration through a canvas bag followed by treatment of the residue in a press allows of the recovery of most of this oil in good condition.

Distilled oil of limes is obtained by distillation of unsettled lime juice before concentration or conversion into citrate. It is a water white liquid inferior in aroma to ecuelled oil and fetches a much lower price.

It is an unfortunate fact that the production of the less valuable distilled oil should greatly exceed that of ecuelled oil. The reason is, however, the slow and laborious processes involved in the recovery of hand pressed oil. In this connection it may be instructive to review the processes of oil recovery in use in other citrus districts.

In Sicily the larger portion of the lemon oil produced is hand expressed. The fruits are cut into two portions and the pulp removed from each half by a sharp edged spoon and passed to presses for juice extraction. The peels are thrown into cold water to render the cells turgid, are allowed to drain and are then squeezed by hand so that the issuing oil and water are caught in a small sponge which when saturated is squeezed. The resulting mixture of oil and water is allowed to settle, and the oil is then drawn off, filtered through paper and stored in copper containers. Various machine processes have also been used during the last few years. Two of the best known are summarised below.

The Lo Verde machine operates on the whole fruits, which are grated below the surface of slowly running water and are rejected into a chute, while the emulsification of water, juice and oi passes into a settling tank where the oil collects in the surface layer. It is skimmed off and transferred to sponges, which are squeezed in bags in hydraulic presses, the exuding oil and water being separated in a separating funnel.

Bennet's process consists in crushing the whole fruit between rollers and separating the oil from the juice, in a centrifugal machine of the milk separator type.

The quality of the machine made oil is said to be inferior to that of hand expressed oil partly owing to the relatively high solubility of citral in water whereby the machine-made oils are poor in this constituent.

In the United States of America where labour is expensive and no hand pressed oil is produced, various machine processes are used. In all of these the first stage consists essentially in the separation and grinding of the peel. The oil is subsequently recovered from the ground peel by extraction with a volatile solvent or by steam distillation in vacuo or by the application of pressure in powerful hydraulic presses. In the last process the expressed oil is in the form of an emulsion with water, stabilised by various gummy constituents of the peel, and cannot be separated by any of the usual methods.

It is found, however, that on treatment with a gelatine solution and then a solution of tannin a coagulum is formed from which a separable mixture of oil and water is expressed on subjecting to pressure in flannel bags. It is claimed that oils prepared by any of these three processes compare favourably with Sicilian hand pressed oils.

From the foregoing it would appear that any extension of machine processes to the production of lime oil should be along the lines of the American rather than the Sicilian methods. Solvent extraction would hardly be possible in the tropics, but it is intended to investigate the possibilities of the other processes as applied to lime peel. If successful, the question of obtaining a suitable peeling machine will merit serious consideration.

As is well known when limes which have not been ecuelled are passed through the mill, the greater portion of the essential oil passes into the juice and on standing collects chiefly in the pulp layer, which forms the scum on settled juice. This oil is ordinarily recovered as distilled lime oil. Both distillation under reduced pressure and the gelatine tannin process have been tried with the pulp in both cases without success.

Hardy has found that when lime pulp is distilled under a pressure of 100 mm., although the distillation temperature does not exceed 53 C. the product resembles ordinary distilled oil. Apparently the acid and water present accelerate the decomposition of the oxygenated constituents of the oil even at this temperature. In McDermot's vacuum distillation process which is stated to give excellent results, dried ground peel is distilled in a slow current of water vapour which serves merely to carry over the vapourised oil.

The gelatine tannin process yielded no oil at all, which is hardly surprising in view of the low percentage (7%) of oil in the pulp and a high percentage of bifrous material.

An attempt to extract the oil by mixing the pulp with filter cel, fuller's earth or some other finely divided rigid solid, followed by pressing was only partly successful, about one-fifth of the total oil present being recovered.

The recovery of oil from the skins of crushed limes has recently been investigated. In one experiment with lime skins from an Antigua lime factory, it was found that distilled oil to the extent of 0.25% of the weight of skins taken could be obtained when they were ground in a mincing machine and steam distilled. With such a low yield it would hardly be economical to carry out the process unless the ground skins were to be further used as a source of pectin.

The manufacture of concentrated and terpeneless citrus oils is a phase of the industry which so far has not been attempted in Dominica. Recently, however, some interest has been evinced and laboratory experiments in the manufacture of concentrated lime oil have been carried out.

By distillation of hand pressed lime oil at 90—100mm. pressure most of the terpenes are removed below 110° C. and a residue equal to 25—30% of the volume of oil taken is left in the flask. On treating this with alcohol a yellow solid is precipitated leaving a clear greenish yellow liquid smelling strongly of the fresh lime fruit. It is hoped that this extract may be of use as a flavouring essence.

Terpeneless oils are manufactured by distillation of the terpenes in vacuo and then steam distillation of the residue at ordinary atmospheric pressure. They therefore differ from concentrated oils in that the resinous matter and other non-volatile constituents are absent. It is stated that the yield of terpeneless lemon oil is about 5% of the oil taken.

The author has not been able to obtain any information as to the yield of terpeneless lime oil but it is hoped to conduct laboratory experiments on the manufacture of this product at an early date. From the relative prices of hand pressed lime oil and terpeneless oil (6/6 per lb. and 30-40/- per lb. respectively) it is reasonable to suppose that the yield is considerably greater than that recorded for lemon oil.

Should terpeneless oils be manufactured in Dominica there would be a market available as firms both in the United Kingdom and in the United States of America have expressed their interest in the matter and have asked for samples. There would also appear to be a market for the terpene fraction.

The question of the storage of citrus oils merits some attention. It is well known that citrus essential oils rapidly deteriorate on exposure to the air especially in the light and acquire an unpleasant turpentine like ordour. If the oils are stored in tightly closed vessels which are filled completely and kept from the light, although there is a very slow decrease in the citral content, accompanied by an increase in the resinous constituents and in the Specific Gravity, there is no change in the aroma.

The addition of 10% by volume of absolute alcohol greatly increases the keeping qualities of the oils and it is stated that 1.5 to 2% of olive oil also affords some protection. It is interesting to note that it is claimed that oils prepared by solvent extraction processes possess exceptional keeping qualities. This is attributed to their high resin content.

The containers used for storage should be made of glass or of tinned copper. Tinned iron vessels are undesirable as any imperfection of the tinning exposes iron which may result in darkening of the oil.

Fruit Preserves and Pectin.

A. Preserves. Department Circular 232 of the U. S. Department of Agriculture contains detailed instructions for the preparation of various citrus fruit preserves, including the following:—candied orange and grape fruit peels, orange marmalade, grape fruit marmalade, orange and grape fruit jellies and orange butter. It seems probable that certain of these might be manufactured profitably from the waste fruit on the Imperial Road. It is realised that the question of transport is a serious factor in the development of any industry in the interior of Dominica. Fruit preserves would, however, be more easily handled

than fresh fruit and each package would represent a greater value than an equal bulk of the fruit in fresh condition.

B. Pectin. The well known fact that fruit juice when evaporated with sugar tends to form a jelly is due to the presence of pectin. This substance is soluble in water, or properly speaking forms a sol with water which in acid concentrated saccharine solutions sets to form a gel. The proportion of pectin normally present in fruit juices is comparatively small but the cell walls of parts of certain fruit consists largely of pectinogen, an insoluble substance convertable into pectin by certain enzymes or by the action of acids. In the case of citrus fruit, the inner white, peel is rich in pectinogen so that the skins of such fruit are potential sources of this product.

During recent years pectin has found some use as a substitute for gelatin in the manufacture of jellies and as a filler in ice cream preserves and certain types of confectionery.

It is possible that it may be profitable to prepare pectin from the lime skins which form so large a by-product in the lime juice and cirtic acid industries.

The pectin content of oven dried peel (white and yellow) of Antigua limes has been found by the author to be 31%: this corresponds to about 1.3% on the whole fresh fruit. Oranges purchased locally contained about 1.2%.

It is stated that of all citrus fruits grown for commercial purposes the grape fruit is the richest in pectous matter.

The preparation of pectin from citrus fruit involves two main processes: the extraction of the pectin and the recovery of the pectin from this extract in a marketable form. The literature dealing with the subject is abundant but is frequently confusing and at times contradictory. The question of extraction has, however, been considerably clarified by work recently carried out at the Imperial College of Tropical Agriculture. Further work along similar lines is now being conducted at the Federal Laboratory in Antigua, where attention is also being given to the second phase, viz., the conversion of the pectin extract into a marketable product.

Lime Seed Product.

The average lime crop in Dominica up to the present one, which has been exceptionally poor, amounted to about 400,000 barrels, each barrel containing the equivalent of 3 lb. dry seeds, i.e., about 535 tons seeds in all.

Of this quantity a small portion was used as planting material and a somewhat larger portion used as a cattle food and as a manure. The bulk of the seeds were disposed of as waste material, frequently being thrown into the nearest river when in flood.

The question of the utilization of this material was first mooted by Tempany who determined the oil content of the seeds and their food and manurial values. No further developments followed until in 1922 when the recovery of the oil from the seeds was investigated at the Antigua laboratory.

The process of recovery is simple. The seeds are crushed and the meal warmed to about 120° F. and pressed in bags. In the laboratory experiments a yield of about 27% oil was obtained using a small hand press. This is a recovery of 70% since the ground seed was found to contain about 40% oil as determined by ether extraction. It is probable that on the large scale where hydraulic presses were used the recovery would be higher.

A sample of the oil was sent to the Imperial Institute for valuation and a report was received to the effect that the crude oil should be saleable in moderate quantities in the United Kingdom if it could be offered at a price not exceeding £30 per ton, c.i.f. (September 1922). It was also stated that the crude oil would be suitable for soap manufacture.

In view of the large quantity of common soap imported annually into the Leeward Islands (value about £18,000 in 1920) it was considered desirable to investigate the possibility of manufacturing lime seed oil soap locally as a possible substitute for part of the quantity now imported. The result of this investigation has recently been published in the Dominica Gazette under the heading "The Manufacture of Soap from Lime Seed Oil."

A fair quality soap can be made from lime seed oil mixed with 20% of its weight of resin at a cost from materials of not over 2.2d per lb. Common soap is sold in Antigua at about 6¾d per lb. so that the cost price of the materials allows 4½d per lb. to cover fuel, labour and marketing expenses and to allow for profit on the venture.

The feeding value of lime seed press cake compares favourably with that of cotton seed press cake and its manurial constituents (Nitrogen, Potash and Phosphoric acid) are in excess of the quantities found in pen manure.

Actual feeding experiments have been conducted on only a very small scale owing to the small quantity of the press cake obtainable with the laboratory hand press. It was found, however, that horses, mules, and cattle either ate the cake readily or could be induced to do so.

As a manure the press cake is superior to the untreated seeds, for not only is the proportion of its manurial constituents higher, but the removal of the oil allows quicker decomposition in the soil and therefore increased its availability.

In conclusion it may be stated that the manufacture of these lime seed by-products is simple and the outlay for machinery and working expenses should not be large, especially at any of the larger lime factories where heat and power are already available.

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(15) F. Hardy — West Indian Citrus Oils and their Recovery. Agricultural News Vol. XX. p. 68.
(16) See (5).
(17) H. F. Zeller — Some Constituents of the American Grape Fruit (*Citrus Decumana*) J.I.E.C. Vol.X. p. 364.
(18) H. A. Tempany — Note on the Feeding and Manurial Value of Lime Seeds. W.I.B. Vol. XV. p. 27.

The President: We might take another subject which is not unrelated to some of the points Mr. Nosworthy has drawn attention to with respect to the fruit trade and fruit industry. Mr. Ogilvie has something which he wishes to present with regard to quarantine against plant diseases—a matter of great importance not only to the island from which he comes, but to Jamaica and all the other islands.

"AGENDA PUT FORWARD BY BERMUDA DELEGATE."

Lawrence Ogilvie. m.a., b.sc., Government Plant Pathologist.

1. *Recommending Government Inspection and Certification of Exports of Nursery Stock, to Control the Dissemination of Plant Disease and Pests.*

Sir—As delegate from the Bermudan islands it gives me great pleasure to convey to the representatives of the West Indian Colonies a hearty greeting from the Board of Agriculture of Bermuda and the farming community generally. I carry also the apologies of the Director of Agriculture of Bermuda for his unavoidable absence from this conference.

The first matter to which I desire to draw your attention is one which concerns not only Jamaica and Bermuda, but the West Indian Colonies as a whole. I refer to the dissemination throughout these islands of various extremely destructive insect and fungoid pests on plants. I may mention as an example the Citrus Black Fly (*Aleurocanthus woglumi*), which appears to have arrived here from the East and has been spread thence to other West Indian colonies, such as the Bahamas, where it has brought about immense losses in the citrus industry.

The prevention of the dissemination of such diseases and pests is of course attempted by individual countries by means of quarantine regulations, (1) prohibiting the importation of host plants of known dangerous diseases, or (2) enforcing the inspection, and, if necessary, fumigation of suspected plants on arrival, or (3), requiring the production of a certificate from competent authorities in the country of origin that the plants are free from certain diseases.

Countries which have been most harassed by the introduction of alien plant diseases have now instituted these three barriers against them.

This is the case in Canada and the United States. Thus under the Destructive Insects and Pests Act of Canada of June 26, 1923, no nursery stock from any country other than the United States is admitted into that Dominion, unles under special permit and accompanied by a certificate of inspection by an authorized official of the country of origin stating that the nursery stock has been found to be apparently free from any pest or disease. Such stock is also examined by an inspector of the port of entry before being allowed to proceed to its destination.

The Bermudan islands, under section 29 of the Agricultural Inspection Act of 1921, require the inspection of all bulbs and other nursery stock exported from the islands and the certification of the same as free from injurious plant diseases and pests.

During the three years 1921-23 our islands have spent over £4,000 in an endeavour to control the West Indian Peach Scale (*Aulacaspis pentagona*) which devastated the oleander hedges, one of the chief beauties of the island. This scale was almost certainly introduced on nursery stock imported from the West Indies about the year 1917, before the appointment of a Plant Pathologist in Bermuda. We have also to lay to the account of the West Indies the Banana Borer (*Cosmopolites sordidus*), destructive to our banana plantations, and possibly the Purple Scale of Citrus (*Lepidosaphes beckii*).

In view of the extreme danger of promiscuous exchange of nursery stock and of the drastic steps being taken elsewhere in this regard it appears to me that much closer co-operation between the West Indian colonies is desirable to forward the quarantine and control of plant diseases and pests.

I am asked to put forward the suggestion that the West Indies should as far as possible institute Government inspection and certification of exports of nursery stock to control the dissemination of plant diseases and pests.

This may appear to involve duplication of work, but in our opinion it would serve a very useful purpose in safeguarding the economic plants of the West Indies as a whole.

Such a system would tend (1) to protect those islands unable to maintain an efficient inspection service, and (2) to lessen the danger of any surreptitious transportation of nursery stock.

2.—*Recommending Government Inspection of Exports of Fruits and Vegetables to Control the Dissemination of Plant diseases and Pests, and to secure Uniformity and Improvements of the Grades Exported.*

Sir,—The second matter to which I am asked to draw your attention is one in which Bermuda has had long experience and in the results of which she is justly proud. I refer to the inspection and grading of agricultural produce.

Prior to the advent of Governor Reid (1839-46) the possibilities of agriculture as a factor in Bermuda trade had been largely neglected. It was he who first pointed our how these islands, in virtue of their unique climate and geographical position, could serve as a winter garden for the production of vegetables for the ever-increasing New York market.

The export trade was carried on somewhat erratically till 1890, when it was deemed necessary to pass an Inspection Law. The preamble to this Act explains the situation: "Whereas the cultivation of potatoes, onions and tomatoes for export from these islands to America is, and for many years has been, the principal trade of the Colony, and as the practice of shipping small and inferior vegetables, packed in such a

manner as to deceive purchasers has resulted in great damage to the trade and may cause its total loss, to prevent this if possible, it is deemed expedient to provide some means of inspecting these vegetables before shipment."

About that time our chief export to the United States was tomatoes. The Act, unfortunately, came too late to save our market in this commodity. A maximum export of the value of £13,718 was reached in 1871, in 1891 it fell to £814, and in 1904 it reached a negligible quantity, namely £3.

Our market in onions, a crop peculiarly fitted to the Bermuda soil, has been similarly threatened from time to time. Opposition was put up by Texas, the industry there being subsidised and protected by a heavy tariff. At the present time, Bermuda exports onions to the value of some £23,000 annually, some 53 per cent. of the total going to the United States, some 30 per cent. to Canada, and some 17 per cent. to the British West Indies.

Recently, increasing attention has been paid to green vegetables and despite rapid development in the truck crop industry in the southern United States and the imposition of heavy duties on foreign vegetables Bermuda has held her trade. Her export of agricultural and horticultural produce, namely, potatoes, onions, green vegetables, lily bulbs, is and always has been, somewhat precarious and it is only by paying constant and close attention to economy and efficiency in production, to the growing only of the most suitable crops, to control of diseases and pests, to co-operative buying and selling, to extension of markets, and most important of all, to securing the best possible methods of grading and inspection that she is able to maintain that position.

I shall not go into the question of our inspection laws in any detail. Our inspection staff consisted at first of one inspector employed from January to June inclusive with a salary of £100 per season. Now we have one inspector at a salary of £350, an assistant inspector at £20 per month from January to June, and sub-inspectors at 20/ per day, employed as required. In 1923 the service cost about £900.

The chief inspector is stationed in New York during the greater part of the season and informs the Director by cables regarding market prices of Bermuda produce and other matters concerning market conditions, and this information is published locally by telephone, notices posted at the dock and elsewhere and through the press. The inspector advises t' e receivers with regard to crop conditions in Bermuda and is able to a limited degree to prevent price cutting. He is also able to direct the attention of the steamship company to transportation matters calling for improvement.

In 1921, mainly through the activity of the present Director of Agriculture, all the Acts dealing with the subject were consolidated and amended. The Agricultural Inspection Act of 1921 provides for inspection and control of the following exports, potatoes, onions, green vegetables, lily bulbs, and other nursery stock; and the following imports, seed potatoes, and vegetable seeds.

In the Act of 1921 as little detail as possible was incorporated. Authority is given to the Board of Agriculture to make, amend, and repeal regulations for the administration in detail of the Act. This procedure is an improvement on the former practice of loading an Act with much detail. Regulations before coming into force must be approved by the Governor in Council.

Regulations are frequently amended or repealed, as circumstances indicate. Those now in force provide for :

(1) standard grades of produce,
(2) condition and sizes of packages, and
(3) proper marking of packages and
(4) hours of inspection, etc.

From year to year additional regulations of the conditions under which produce may be shipped are enforced, e.g , in 1913 a standard size of celery crates was required. That vegetable, of which Bermuda exported 28,000 crates in 1922, had previously been shipped in three or more different sized crates. The advantage of a standard crate was at once evident.

Further regulations requiring a standard potato barrel, a standard vegetable crate, and the withdrawal of our No. 3 grade of potato, are under consideration.

The effects of the Inspections Acts have been highly beneficial to the farming community who in 1912 asked for an extension of the power of the Acts then in force.

There are now some 650 persons employed in agriculture in the islands, our annual agricultural exports being of the value of about £250,000. Agriculture must continue to be our standby if in the words of our Governor, Bermuda is to keep its soul.

Were it not for the high quality of Bermuda produce offered for sale in the New York market it would be impossible to maintain our position in that market. Without the inspection carried on under our Agricultural Inspection Act, it would be impossible to keep our produce up to the desired level. Our system has been characterised by Prof. H. E. Babcock, Professor of Marketing at Cornell University, as "probably the most successful example of grading by legislation that exists anywhere."

My intention in bringing these facts before you, Sir, is to suggest that some similar course might be adopted with regard to fruit other than bananas exported from the West Indies, and especially with regard to citrus fruits. I am told that Canada imports from California annually some two million boxes of oranges, and that Jamaica is offered by Canada a preference duty of one cent per pound over non-British oranges provided she can produce the necessary quantity and quality. There may also be a market in such fruits as mangoes, avocado pears and sapodillas. We in Bermuda could probably take large quantities of your citrus fruits and avocado pears and possibly other fruits and vegetables during our tourist season, provided they had the uniform quality which could be obtained by grading. At present West Indian fruits retail in Bermuda at high prices because of losses in shipment. Cheaper (and better) fruit would mean very much more consumed. The value of our total imports of fresh fruits in 1912 amounted to £21,418, of which only £3,640 worth came from the West Indies. (The amount of bananas imported is negligible, owing to our prohibitive tariff of 2/6 a bunch.)

I take it that the fruit trade other than bananas, arriving in Bermuda is a fair sample of what you export. It arrives in Bermuda in extremely poor condition. This is due to—

(1) Lack of fast boats fitted with cold storage accommodation. This matter is of course of extreme importance. A frequent service of such boats between the West Indies and Canada, calling at Bermuda en route would revolutionise the trade in agricultural produce between the British Colonies and Dominions of the western hemisphere It would open up markets both for the West Indies and for Bermuda.

Canada imports annually from the United States over 1½ millions of miscellaneous green vegetables. Some of these could come from Bermuda. During the last twelve years the West Indies have taken 4 per cent. of Bermuda's agricultural produce. The trade has been very erratic, the value of onions exported during the period fluctuating between £2,000 and £22,000, and potatoes between £200 and £8,940. A regular market might be developed in these commodities and possibly in certain vegetables if transportation were improved in the way suggested. I believe this important question of transportation is now receiving attention in Canada.

(2) Careless packing—Boxes of grapefruit arrive in Bermuda only three-quarters full. In consignments sent to England there is generally an appreciable shrinkage, but this should not occur during the short trip to Bermuda.

(3) Lack of grading of fruit—The fruit varies very much in size and quality. It should be reasonably uniform, and in the case of citrus fruits, free from scale, and not too ripe. The mangoes exported to Bermuda are generally of very poor quality.

The inspection and grading of fruit and, if thought necessary, of vegetables, exported would have the additional effect of reducing somewhat the exportation of diseases and pests on the produce.

I am asked, therefore, to respectfully recommend for your consideration Government inspection of exports of fruit and vegetables to control the dissemination of plant diseases and pests, and to secure uniformity and improvement of the grade exported.

The President: I am sure that the points Mr. Ogilvie has raised will evoke discussion. The paper is divided into two—the inspection of fruit and the rigid inspection of exported plants. Hitherto attention had been paid to imported plants, now it goes further for the protection of other people. If we do not protect other people they will not protect us. With regard to the grading and packing of fruit, most of the steps have been discussed in other islands and in Jamaica. I am sure there will be several gentlemen who wish to express views on the points brought before the Conference.

Mr. Cousins: I would strongly advise Bermuda to do what Jamaica has been doing and put an absolute embargo on any importation of crops or plants. At the present moment we have enforced an order which absolutely prohibits any importation from Trinidad, Barbados and Bermuda without special permission. It is only through very strict embargo we have succeeded in maintaining our cotton production. We have kept out the pink boll worm, and we have at the present moment a strict embargo. We absolutely refuse to give the sugar planters permission to import sugar cane. What I think we very much require is the assistance of the authorities at Kew in the same manner as the American Government's Departments, a sort of clearing house in sending plants from one country to another. Plants can be sent out under supervision to experiment stations. There is no doubt that terrible tragedies have occurred in the sending of plants to experiment stations. The time has arrived when very great care should be exercised. In this island we have a very strict embargo; if we continue to be so careful in the future even human beings will be prohibited and that would be a good thing for Jamaica.

Mr. Bovell: It is highly desirable that no one of these West Indian islands should allow any plant to come in. Not long ago a lady went to Trinidad and got a lot of plants and a certificate, but when she arrived at Barbados, much to her annoyance the plants were destroyed.

With regard to sugar cane, no plant at the present time can be imported into Barbados. I think that it would be a good thing for this Conference to pass a resolution proposing that all the islands fall into line in this matter of quarantine; this resolution to be sent to the various governments.

Professor Ballou: I would like to say that protection should be from the point of origin. There are many places where certificates are required, and I take it that the experts would consider this question of certificates. The greatest good would be obtained, I think, if we had certificates from the point of origin. And if people were taught the conditions of shipping in a short time we would get better fruit. The greatest benefit would come from teaching the people what it means to have good articles exported. I have heard of a good many cases where experts, though they may have been very conscientious did not correctly represent the articles exported. I do not care how good the entomologist is, these cases will occur. It seems to me that so long as one country has something which the other wants, there must be trade, but they want to be absolutely certain of the least possible chance of disease.

The President: I beg to remind the Conference of the demonstration of live stock at Hope to-morrow morning, and afterwards we meet at 11 o'clock at the Institute of Jamaica, which is better for several reasons, chiefly its better acoustic properties.

The Conference then adjourned to the next day.

FOURTH DAY.

The Conference resumed its sittings at the Institute of Jamaica at 11 a.m. on Thursday, 31st January, 1924, under the presidency of Sir Francis Watts, K.C.M.G.

The President: Before we procced with the order of the business, I shall read to you a telegram which His Excellency the Governor has received from the Secretary of State for the Colonies with the request that it be communicated to the Conference.

"Convey to Delegates Agricultural Conference my thanks for their telegram 29th January and assure them that I fully realise predominant part played by agriculture in life of tropical colonies."

"EXPERIMENTAL WORK ON CACAO."

BY

W. Nowell, D.I.C.

The President: Owing to indisposition Mr. Nowell could not attend yesterday to give us his paper on the experimental work on Cacao that was being carried on at River Estate in Trinidad. It is too important a matter to omit and I will now call upon Mr. Nowell to give us this information

Mr. Nowell: I am sorry that I could not attend the Conference yesterday. That was due to circumstances over which I had no control. I have here to-day three classes of material. First of all, I have a short summary of the commercial aspect of River Estate, Trinidad, as a Government Institution. I have made some notes on the experimental work that is being carried on at River Estate drawn up by

Cacao men. This Estate has only been established now for a few years and I also have some rather lengthy tables which show the detailed results of the various places and the various points that have been, and are being, tested at River Estate, but I do not propose to put you to the trouble of hearing them. They will read very much better and be more useful when they are printed in the proceedings of this Conference. Perhaps the most interesting aspect of River Estate to a general Conference like this is the commercial aspect. I had this morning the great privilege of seeing something of a commercial undertaking in Jamaica run by a Government Institution. That was on the occasion of our visit to the Hope Farm. There is a strong feeling amongst the general public, which is often shared by Governments themselves that no Government Institution can be carried on and be a commercial success. That is, so far as I can judge the opinion of the Trinidad Government, because they insisted when appointing delegates to this Conference that they should consist of one officer from the Agricultural Department of the Colony and one planter. River Estate was purchased by the Trinidad Government and the purpose of its purchase had been entirely remote—it was not agricultural in any sense. The estate had been purchased in connection with the water supply of Port-of-Spain. It consisted of 5,000 acres, and at the time of the purchase it was derelict cacao land and forest land. It served, first of all, as an object lesson of what could be done in the rehabilitation of cacao land which had got into a derelict situation, and that was the most important function of River Estate. There are a good many areas in Trinidad which would benefit greatly by the application of some sort of work as that carried on at River Estate. Experimental work carried on there is as yet indefinite in its results; I think it will be some years yet before any sound conclusions could be drawn either way with regard to experiments on River Estate. In 1904 there were about 20,000 bearing cacao fields with an annual crop of 185 bags of 165 lbs. There were no other crop trees grown besides cacao. In 1908 the Department of Agriculture took over the estate from the Botanical Department; it then contained about 26,000 bearing cacao trees with an annual crop of 185 bags of 165 lbs. Up to 1925 no other crop plants besides cacao were grown, but in 1916 new plantations of limes, timber, etc., were started. In 1921 there were 134,000 cacao trees at stake of which 40 per cent. were young bearing trees, seedlings or mere stakes. The crop for the year was 1,272 bags of 165 lbs. At the end of the year besides cacao, there were planted extensive areas of timber, coffee, lime, tonca bean and fruit orchard. Very extensive and valuable improvements and additions had been made to the buildings, water supply, the pasture, etc., and other conveniences, at a great cost during war time when labour and materials were expensive. The total value of the estate in December, including cacao and other plantations was £29,000. Experimentation work cost nearly £2,000. The Statistics in connection with River Estate are as follows:—

1897. Purchased for $24,874.50. Total amount for sale of Cacao and Land Rent $1,307.66.

1899. Leased for yearly rent of $1,800.00.

1904. Took back estate and paid Lessor $6,240.00. There were about 20,000 bearing cacao trees with annual crop of 185 bags of 165 lb. Total net cost of Estate now stood at $20,832.49. There was no other crop tree grown besides cacao, and the cacao fields when taken over

from the Lessor were in a neglected condition. The estate was just a trifle more valuable than when it was first bought by the Government. Buildings were few and not valuable except two small cacao drying houses with attached store-room, etc.

1908. Department of Agriculture took over the Estate from Botanical Department. It then contained about 26,000 bearing cacao trees, and the year's crop was 339 bags of 165 lbs.

1915. There were about 80,000 cacao trees and year's crop was 704 bags of 165 lbs. No other crop plant besides cacao was grown up to end of this year. In December the estate paid from its revenue the purchase cost, all advances by the Colonial Treasury, all expenses in connection with its working and developing and had a surplus balance of $5,496.47 to its credit. At this time it had spent $48,637.51 on Capital Account and the value of the estate was then approximately $70,000 to $75,000. An entry dated 20th February in Cash Book, audited by Auditor General, shows repayment to the Hon. Receiver General of the sum of $4,686.17; this was the repayment in full of all advances made by the Government to River Estate.

1916 New plantations of Limes and Timber, etc. were started.
1921. There were 134,000 cacao trees at stake of which 40 per cent. were young bearing trees, seedlings or mere stakes. The crop for the year was 1,272 bags of 165 lbs. At the end of the year besides cacao trees there were planted extensive areas of timber, coffee, lime, tonca bean and fruit orchard. Very extensive and valuable improvements and additions had been made to the buildings, water supply, pasture, etc, and other conveniences such as bath room, modern type of lat ines, etc., had been made at a great cost during the war time when labour and materia's were expensive.

The approximate value of the estate in December including cacao and other plantations was $145,000 and it owed no debt.

The total expenditure since its purchase in 1897 including experimentation and all other extraordinary expenditure on Capital and other account was $234,958.49 and the total gross revenue for the same period was $252,769.78. On buildings and new cultivation other than cacao $28,434.92 was spent, as well as $3,043.96 on Agr cultural Education, $1,408.07 on entertaining Agricultural Societies and visitors interested in cacao and general agriculture. Experimentation work cost altogether $9,680.00.

These are the results which have been achieved at River Estate, and any planter who pays a visit to the estate will agree that there are a great many lines to work on in its development which will prove very valuable assets in future at no very considerable further expense. The results are very valuable as showing what can be done by an extensive cultivation of land which has been allowed to run into a derelict condition. River Estate has one great advantage over private capital because it had the use of capital supplied by the Government without interest and this capital has been used in its development. It is important for private individuals to have access to capital like that and it shows that the present movement in Trinidad to provide capital in this manner is moving on right lines.

"NOTES ON EXPERIMENTAL WORK ON CACAO AT RIVER ESTATE."

BY

L. Seheult, B.Sc.

(Communicated by Mr. Nowell.)

The present Experimental work at River Estate dates from 1910 when plots were selected for manurial, shade and no shade and chupon experiments. Other plots, for other purposes have been added subsequently. The results up to 1917 from the older plots were fully reported on by Mr. J. deVerteuil, in the *Bulletin* of the *Department of Agriculture* and summarized in Volume XVI, 1927, 176,188. The work has been continued (excepting manuring) but there are no striking new developments to report now.

At an early stage in these experiments attention was drawn to the variation in yield of individual trees, and records have since 1912 been kept of the number of pods borne per year of each tree. The total number of trees of which such record is kept at present is about 14,000. The results showing consistent heavy and poor bearing trees, are the basis of some of the later work.

The newer experiments include the following:—

(1) Distance apart, planting with and without shade;

(2) Comparative results from seedlings, budded and grafted plants raised from selected parents that are consistent good bearers;

(3) Colour of pod plots to ascertain the correlation, if any, of pod colour and the influence of weather or season, in regard to bearing; twin plantings of seedlings and budded plants as well as two budded on one stock, each one of the pair differing from its companion in colour of pod.

(4) An isolated plot of one acre planted entirely with seedlings from one tree having a very high bearing record; from this and the budded and grafted plots information as to inheritance of good bearing quality, will be got. The trees in these newer plots are as yet too young to allow definite conclusions being drawn, but in a few years these experiments will be valuable aids in the study of cacao; later on it will be possible to duplicate on them other experiment work which is now carried on in plots scattered here and there through 600 acres of cacao, which makes observation, especially in regard to comparative work, more difficult and less reliable than would be the case if they were more concentrated. The new plots also have the very valuable advantage over the older ones of uniformity in soil and surroundings, in the care exercised in the selection of the cacao plants they contain, and in the treatment these plants have received since infancy. During your visit to the cacao fields the system of work and the results obtained have been explained.

In No. 1. Field there were formerly 26 manurial plots receiving yearly application of manures from 1910 to 1917. It was found that it did not pay to apply most of these manures at short intervals, because although the yield was increased it was only in a few instances that there was a profit after deducting the cost of the manures. As these results were obtained in fully shaded cacao, where the true worth of a manure cannot well be ascertained, it is proposed later to repeat manurial experiments with partially shaded, non-shaded, and fully shaded

cacao but with applications of manures at longer intervals. The results so obtained should be more satisfactory than those from the first experiments. As already mentioned it was during these experiments in Field No. 1. that the characteristic of consistency in bearing quality in the cacao tree was first recognised; this peculiarity was also noticed, about the same time, in the United States among orange trees, and from this has sprung up the idea of propagating budded plants from prolific trees, and also budding from good trees on to the stumps of unprolific ones. Selection of good bearers as parent trees is a positive necessity in cacao estate development and also in replacement or supplying. After an interval of about two years, when manures could not be imported, the manurial plots in Field No. 1 were converted in 1919 into non-shade ones. The permanent shade was destroyed in one period without any special preparation for this big change, except the previous applications of manure. The consequences are not accurately ascertainable now because the change is recent. That sudden removal of shade is a great set back is shown by the records of some of the trees for period before and after the removal of shade.

In contrast to this, Field No. 19 which is not an experiment field, but was visited to-day because it was formerly a poor yielder, the permanent shade was gradually reduced, in 1919 by 50 per cent. because the shade trees were closely planted, and in 1920 period by another 50 per cent. of the remaining immortels, therefore the field now contains only a quarter of the original shade trees. During the year previous to the reduction of shade the weak spots in the field were improved by tilling, manuring, mulching, and planting temporary ground shade and the cacao trees pruned very slightly or not at all, in preparation for the coming change. Later on whilst reduction of shade was going on the field was thoroughly forked, all debris being buried, and manure and mulch applied where required. In thus dealing with the reduction of shade there was never a set back but on the contrary new growth and accommodation to the new condition began at once, and the field improved. In shade reduction it is indispensable that the trees should be in good form for quick growth, and also that where the soil is not already so, its conditon should be adjusted to suit the greater exposure to sunlight and wind—two factors that increase transpiration. The shape of the crown of a tree exposed to wind is quite different from that of the heavily pruned cacao tree growing under thick shade, a skeleton shape of that sort is nearly always fatal in severe shade reduction; and in preparing a field for shade reduction as many leafy twigs as possible must be left on the tree to fill up or make a compact umbrella-like but flattish crown.

Field No. 5 contains three comparative plots of Full shade, Partial shade and no shade, the trees on their plots are about 40 years old and the shade was removed twelve years ago. The no shade plot had the disadvantage for many years of having a deep bamboo border fringingi ts northern boundary; this was destroyed in 1918–1919. I cannot help making the reflection that had there not been this bamboo border this no shade plot would have given better results. The full shade plot besides being the poorest yielding plot is also the one where most diseased pods appear. Here are the records of yield 1916 to the present experiment year which ended in August.

Partial shade gives the best returns, then follows No shade and Full shade.

The three non-shade plots of No. 20 Field and the three partial shade ones of Field No. 21 gave the following returns.

The cacao trees in the shaded plots of Field No. 21 are two years older than those of the non-shade plots Field No. 20, and in 1910 when the experiment started the yield in bags per 1,000 bearing trees was in no shade plots $4\frac{1}{4}$ bags, in the partial shade $9\frac{1}{2}$ bags.

I believe that intensive cultivation and reduction of shade with only light but regular pruning of the cacao trees, are the best processes for permanently improving cacao fields and yields, and when combined with replacement of poor bearers by chosen seedlings or budded plants of known good bearing quality, cannot fail to be profitable to the grower. In addition to securing by intensive cultivation and reduction of shade more permanent improvement, they also ward off the attacks of insects and disease, and give a greater control over the influences of unfavourable seasons.

I am fully aware that the non-shade condition cannot be practised in many places but there are few places where, when there is shading, it cannot be reduced with advantage. I think the greatest cause of decline in the yield of cacao estates is overshading and excessive trimming. If there is no over shading there need not be heavy pruning; one is the consequence of the other; there is no necessity for either. In connection with this in a report of mine to the Director of Agriculture I said: Because it is generally said that my success at River Estate is attributable to its favoured s tuation and environment, I am of opinion that it has become necessary that the Department should own a small property on which to duplicate the useful past of the experimental work that is done here; such an estate should be situated where such adverse conditions exist as are generally met with by planters who do not seem able to succeed.

In Field No. 2 in accord with what had been found out in regard to stability or consistency in bearing, all consistently bad bearers were either destroyed and replaced by seedlings or budded plants from heavy bearers, or cut back to stumps on which buds from similar heavy bearers were grown. There is no difficulty in growing buds on new stump growth but the difficulty is in getting low cut stumps to live, and tall stumps to produce basal suckers or chupons. A very high percentage of low cut stumps die—68%. I think a better system would be to induce basal sucker growth before cutting down the main tree; a suitable growing season should also be selected. Chupons or suckers growing on the upper end of a tall stump are quite useless. I think replacement by budding is useful to improve the yield of cacao fields.

The cultural experiment plots cannot be considered satisfactory for comparative purposes because the field which contains these plots was until quite recently, not sufficiently uniform. Although as I have said it is not possible to get good information from the younger plots, as an interesting beginning I may mention that both the non-shaded seedling and budded plots have given much higher yield than the companion but shaded plots in the three years 1919-20, 1920-21, 1921-22. In the distance plots the best yield so far is from the trees at 12 x 12 apart.

There is a belief in Trinidad that it is possible to select certain varieties in order to keep your cacao uniform over a certain period. We have all proved that budded cacao or seedlings is not a success. River Estate has produced the material from which a judgment can be obtained and that material is now of the age of about 12 years.

With regard to shading this is a most important question. The experiments at River Estate have proved this: To remove the shade from a tree that has been heavily shaded is very drastic in its effect, and is a process that should only be undertaken with a great deal of caution. If you feel that it is necessary to have your shade removed, you should proceed cautiously.

Capt. Hill said: With regard to the seedlings, I would like to know if the seedlings that are raised from good trees are uniform in character or whether they are very different—whether the cutting out of shade is not one of those psychological questions very much dependent on the weather and the nature of the place—whether it was not rather an individual question rather than a general proposition that could be applied here and passed over every area.

Mr. Nowell said: The seedling progeny of specially selected trees have shown a considerable amount of variation in its development; and this reinforces the opinion that there is a considerable amount of cross-pollination going on in cacao, although we do not know in what way it is effected. As to whether the ultimate results of selected high bearing trees was better or worse, I must suspend judgment until the trees are older; the trees are only nine years old, and I do not think we could get reliable data until the trees are older. The question of shade depends entirely on local conditions. In some areas in Trinidad it would be fatal to dispense with shade trees, and there are other areas where shade trees are mere cumberers of the ground, and are so much waste of space. So far as a general statement can be made in regard to shade, I would say that given ordinary average conditions in cacao, you could reduce shade to the extent that you replace it by cultivation. In the case of cacao, the exact effect is not fully known, and it is an admirable subject for the Imperial College to take up and investigate. Where you have shade trees, the loss of fertility of the land is not so rapid as where shade is dispensed with. You can dispense with shade if the fertility of the land covers the margin, but the amount of cultivation you will have to do to replace the shade will be beyond the practical resources of the planter.

"NOTES ON THE SUGAR INDUSTRY."

BY

G. Moody Stuart.

For twenty years I have watched the striking development that has taken place in sugar making in many parts of the world, and the equally striking absence of such development in other places. The subject is perhaps hardly one that comes strictly within the scope of this conference, at least I have nothing fresh to contribute, nothing to say that is not known to all who have kept themselves informed as to what has been done and what has been left undone—to submit to you to "confer" about. But it is a subject that vitally concerns the well-being of the communities in whose interest the conference has been called, and I venture to take up a few minutes of your time in calling attention to it. My object is not to touch on the various improvements in machinery and in methods that have been brought about by engineers and chemists, but to confine myself to the results of these improve-

ments as realized by those whose living is dependent on the sugar industry. If you will excuse me I will give you my own personal experience. To speak impersonally, to deal with generalties, may be more in accord with polite usage; but if I speak on what I know it is more easy to let you grasp what I want to convey. Well, my experience has been that of a co-proprietor, along with my partner, of estates in Antigua, the most difficult of all the West Indian Islands, for it suffers continually from severe drought, and it has no possibility of irrigation. Twenty years ago we were almost brought face to face with the question of whether to abandon the estates owing to continual losses. There was no chance of finding buyers for them. We were then taking 16½ tons of cane to make one ton of sugar Now we take 8½ and our estates get along very comfortably Some of you may say that our machinery and work must have been very bad in former times. That is true, but many others were doing equally bad work, perhaps, without knowing it, and even now many who have better machinery are taking 50 per cent. more cane to the ton of sugar than is necessary. They may ignore this when sugar is at the present high price. But it is bound to drop sooner or later. Before the war the average price was £11 per ton f.o.b. It was a curious fact that the average, whether you take the average of three years, or seven years, or ten years, was £11. Labour and salaries have risen, I am glad to say, all over the world, and that rise has come to stay, so I think our future average for sugar will be about £14 to £15 f.o.b., when production has increased to keep pace with consumption. Then those who follow wasteful methods of Sugar making will have to face ruin.

The only safe course is to have the making of the sugar done by the best machinery and the best methods. That necessitates a central factory and work on a large scale. Heavy, expensive plant is required, and also considerable annual expenditure to secure the best engineering and chemical control. In my opinion a factory ought to have a capacity to turn out 10,000 to 20,000 tons of sugar in the season. If below 10,000 tons, the fixed charges for expert control are too heavy a burden. A factory, I suggest, implies a company, for the capital involved is large, and company ownership and company management suit factory work well. It is otherwise with the land. Ownership by individuals, whether estate proprietors or small holders, suits the land best. The company that makes the sugar is better to have nothing to do with the land. It should concentrate all its powers on doing the most efficient work in sugar making. But it should have contracts with those who have the land to grow the canes to ensure its supply of canes and their contracts should be on fair profit-sharing terms, so as to give the growers the utmost price for canes that can reasonably be given. As there are some here who are not conversant with the story of modern factories in the British West Indies, may I be permitted to give them some information about the pioneer factory, that in Antigua, to which I referred. You need not, Mr. President, listen to what I now have to say. The idea of that factory was initiated by our honoured president, Sir Francis Watts. The proposals for its establishment were originated by him, and the terms of the contract between that factory and the estates contracting our canes were discussed with, and approved by him. The circumstances were favourable for a fair settlement: for my firm were the largest contractors for canes, so we could readily feel if any proposed clause might prove shoe-pinching to the cane suppliers. We were also the largest subscribers of capital,

the largest shareholders in the factory, so we could readily feel if any clause might produce shoe-pinching to the shareholders. But without Sir Francis Watts we could not then judge what was fair. But he had accumulated all the necessary data. He was able to show us what sugar we should be able to produce. It seemed incredible, but we soon beat his figure. He was able to answer every question, and we had such confidence in his answers that we took a plunge that most people in the island thought rather mad. I am truly thankful that we were mad enough to do so. The contract between the factory and the planter seemed to me at the time absolutely fair. I remember feeling then that there never yet was a better bargain driven. And that is my feeling to-day after twenty years' experience. The final clause in the contract provided that in case of any dispute it is to be settled by arbitration. That is the first and last time dispute has ever been mentioned. There has never been a single question to refer to arbitration. If you want to see *Sir Francis' monument* go to Gunthorpes, Antigua, and look at the factory and the surrounding estates bringing a livelihood to many, where without his initiative there would have been desolation. I hope these remarks may be helpful to those cane plantation owners who may feel anxiety as to the future when sugar prices drop to the normal level. (Applause).

Mr. P. W. Murray: I would like to ask Mr. Moody Stuart what he considers a fair basis of prices to purchase canes for a sugar factory. I would ask him to be good enough to give us some idea as to how this matter is settled in Antigua.

Mr. Moody Stuart: It is a little difficult to state the position here. In Antigua at first it was 4½% and half of the profits after paying certain charges for interest on the capital subscribed. This has since been raised because the canes were found o be richer than was anticipated, and the factory kept on getting out more sugar. The difficulty in Jamaica is that when I was here a year ago I tried to get data, but I could not find how much saccharine was in the canes. My own idea is that a payment of 5% on the F.O.B. prices of the canes as a first payment is a fair one. This sum is needed to be set aside on the capital subscribed and for liquidation of that capital afterwards. The profits should be divided, one half to the plantation owners and the other half to those who furnish the capital for the factory. In Antigua we got grants of £15,000 from the Government which helped us at the time, and that was repaid in taxation to the extent of £105,000, so that the Government received 7 times more than they gave us. The late Mr. Joseph Chamberlain arranged this grant-in-aid and he said he would only do it in Antigua as it was a pioneer factory. A few years ago St. Kitts asked us to erect one there and it was easy to to do it on commercial lines. I calculate that the planters are paid higher prices for their canes than is paid anywhere else. If you take into account that we had a heavy export duty to pay you will see that the full payment came to about 7 or 8%, or to be more correct, I think it was 7½%. If it is a small crop, you can get next to no bonus, but if you have the factory working to its full capacity, the bonus at the end of the year is likely to be large. The question has always been raised as to what is the ordinary F.O.B. price. What we have always done is to get Messrs. Czarnikow, a leading London firm of brokers to tell us the average prices every fortnight and everyone has always been content to take their judgment as to the F.O.B. price.

"EXPERIMENTS ON SUGAR CANE IN BARBADOS."

BY

J. R. Bovel, I.S.O., etc.

Mr. President, ladies and gentlemen: As you are all aware, the object for which Departments of Agriculture with their scientific staffs are created, is for helping all and every one in the country in which they exist; in the case of the Agriculturist, to improve their crops, and in the case of the other members of the community to benefit them through the prosperity of the agriculturists; in other words to help our employers to make money. Therefore, it might not be without interest if I state how far that object has been achieved in the case of the sugar canes in Barbados. That the work of the Department of Agriculture has been of considerable benefit to the colony may be seen from the Sugar Cane Experiment Reports for the period 1913 15 and 1920 22. On the average for those eight years the White Transparent yielded 20.45 tons of canes per acre, the B.H. 10 (12), 29.05 tons Ba. 6032, 31.76 tons of canes per acre per annum, respectively. That is, these two under the same conditions for the eight years averaged 29.22 tons of canes per acre, while the White Transparent averaged 20.45 tons, an increase of 8.77 tons, or 42.9 per cent.

I find from the records in the Department of Agriculture that during the eight years the average price at which dark crystal sugar sold was $4.90 per 100lbs. At this price, and at 7lbs. of dark crystal sugar per 100 lbs. of sugar cane, the value of a ton of canes is $7.68, so that the value of 8.77 tons of canes is $67.35 per acre per annum more than the White Transparent.

From this would have to be deducted the extra cost of cutting loading and carting the better canes, say 72c per acre, leaving a net gain of $66.63 per annum. It is generally estimated at the present time that about 35,000 acres of canes are reaped annually. Assuming that of this area only 20,000 acres were under the seedling sugar canes mentioned above, although I believe that there were more, the value to the growers would at $66.66 per acre be $1,332,600.00 per annum or for the eight years $10,660,800.00.

That the data given above which are based on the results obtained from a large number of experiment plots dotted over the island are fairly correct, I may mention that some of the returns were kindly supplied me by a planter who unfortunately lives in a dry district, where the rainfall from December 1, 1920 to May, 1923, two and a half years, was only 72.45 inches, and so the yields are not as high as in the case of the plots, a number of which are situated in the higher districts where the rainfall is greater, fo the past two years. The White Transparent has given on the average 15.01 tons of canes per acre, while the average for the B.A. 10 (12) and Ba. 6032 is 21.84 tons, which is 6.83 tons of canes per acre per annum, or 45.5 per cent, more than the White Transparent. At $7.68 per ton of canes, the average value of an acre of the two seedling sugar canes over the White Transparent is $52.45 per annum.

As there were on the average 103 acres of the B.H. 10 (12) and the Ba. 6032 reaped for the two years the gain to the estate on the above basis was $5,402.35 per annum. From this would have to be deducted

the extra cost of cutting, loading and carting the canes, say 72c per acre; 103 acres at 72c is $74.16 The net gain to the estate would therefore be $5,328 per annum or for the two years $10,656.00.

The gain from growing the three seedling sugar canes at present under general cultivation is considerably greater, when the saccharose content is taken into consideration. I may mention that in the case of the plot experiments for the eight years there was obtained from the juice of the White Transparent on the average 4,898 lbs. saccharose per acre, while the average obtained from the juice of the B.H. 10 (12) Ba. 6032 and Ba. 11569 was 7,605 lbs. saccharose, so that the average gain of saccharose in the juice per acre per annum for the eight years was 2,707 lbs. or 55.3 more per cent than the White Transparent. I find from the records of two factories for seven years that 91.18 per cent. (in some factories it is said as much as 96 per cent.) of 96 dark crystal sugar was obtained for every 100 lb. of saccharose contained in the juice. At this rate, the average yield of dark cystal sugar per acre per annum for the three seedlings over the White Transparent, was 2,468 lb. The average price at which dark crystal sold during the eight years was $4.90, therefore the increased profit per acre per annum from the three seedling canes was $120.93 without taking into consideration the value of the molasses. This I understand is on the average about 51 wine gallons per ton of sugar. The molasses, therefore, from the 2,468 lb. of extra sugar per acre would be 56 gallons, and as the average price at which it was sold for the past eight years is somewhere about 4 cts. per gallon the value of the molasses would be $2.24, making a total of $123.17 per acre.

As practically the only extra cost of this sugar is certain factory manufacturing expenses and the depreciation of certain machinery, say, $23.17 for the extra sugar and molasses obtained per acre, this leaves a net profit of $100.00 per acre per annum. To make clear what I mean, I may say that there would be less expense per ton of sugar to put canes on a carrier which contained 2.13 lbs. saccharose per gallon of juice than canes which contained only 1.96 lb. saccharose per gallon of juice. The vacuum pan would work a shorter time as the juice from the richer seedling canes would also be purer. The centrifugal, however, would have to work longer. So for 20,000 acres this would be $2.000,000.00 per annum or for the eight years $16,000,000.00. I may further mention that the above increased yield is based on the extraction of the little three roller mill by which the canes from the experiment plots are crushed, and which on the average extracts about 60 lbs. of juice from each 100 lbs. of canes, which is about the extraction of the average three roller mill in an ordinary estate factory. Had the extraction been calculated on the basis of factory crushing 72.13 lbs. of juice out of every 100 lbs. of canes the profit derived by the sugar industry would have been still more than $16,000,000.00. I have used these figures "72.13" because I find from "Cane Sugar and its Manufacture", by H. C. Prinsen Gehrligs, that the extraction of juice without maceration for a three-roller mill is given as 72.13 per cent. He also gives the comparative saccharose content of the juice from the different mills. In this case the extraction of the first mill was 64.50 per cent., the second mill 5.50 per cent. and the third mill 2.13 per cent. The saccharose content of the juice from the respective mills was 12.93 per cent. The ordinary three roller mill, as stated above extracts on the average about 60 lbs. of juice from every 100 lbs. of canes. In calculating the

gain from the extra extraction, I have assumed that the remaining 12.13 per cent. was in the same proportion as that given by Gehrligs. The 60 lbs. of juice would therefore, contain 7.758 lbs. of saccharose, the remaining 4.50 lbs of juice from the first mill at 12.93 per cent. would contain .582 lbs. of saccharose; 5.50 lbs. of juice from the second mill at 11.41 per cent. .628 lb. saccharose and 2.13 lb. juice at 11.30 per cent. .241 lb. saccharose. Therefore 12.13 lbs. of juice would contain 1.451lb. of saccharose. This is a gain of 18.70 per cent. On the above basis the White Transparent would have yielded 5,814 lbs. saccharose while B.H. 10 (12) Ba. 6032 and the Ba.11569 would have yielded 9,027 lb. saccharose per acre per annum, that is, the average gain of saccharose per acre per annum for the eight years was 3,213 lb. or 55.3 per cent more than the White Transparent. I find from the records of the two factories as stated above 91.18 lbs. of 96 per cent dark crystal sugar was obtained from every 100 lbs. saccharose contained in the juice. At this rate the average yield of the three seedling sugar canes over the White Transparent would be 2,930 lbs. dark crystal sugar per acre per annum. As the average price of dark crystal sugar for eight years was $4.90 per 100 lbs. the increased profit per acre per annum from the three seedling sugar canes was $143.57 without taking into consideration the value of the extra molasses. At 51 wine gallons per ton of sugar the molasses from 2,930 lbs. dark crystal sugar would therefore be 66.7 wine gallons, and at four cent. per gallon this would be $2.67 making a total of $146.24 per acre. As stated above, the extra cost of this sugar is certain factory manufacturing expenses and the depreciation of certain of the machinery, say, $23.17 per acre, the net profit is therefore $123.07 per acre per annum so for 20,000 acres this would be $2,461,400.00 per annum, or for eight years $19,691,200.00. It may therefore be said that the sugar industry in Barbados benefited from the planting of the seedling sugar canes in comparison with the White Transparent, during the last eight years, if they had been worked up in a three-roller mill at least $19,691,200.00.

We will now turn for a moment to the estate referred to above, and see how much more would have been gained had the canes been worked up in a factory belonging to the grower. As I have no data as to the working of the factory at which these canes were manufactured into dark crystal sugar, I am calculating the value of the extra gain on the basis of that obtained in a factory with a three-roller mill as that given in the case of the estates dotted about the island.

The White Transparent at this estate averaged for the two years on the basis of an extraction of 60 per cent. 3,971 lbs. of saccharose per acre. The B.H. 10 (12) and the Ba. 6032 averaged 6,637 lbs., that is, the two seedling sugar canes yielded 2,666 lbs. of saccharose per acre more than the White Transparent. As 91.18 per cent. of the saccharose should, as stated above be recovered, the 2,666 lbs. of saccharose would be equal to 2,431 lbs. of 96 per cent. dark crystal sugar.

At $4.80 per 100 lbs. the value of 2,431 lbs. and 55 wine gallons of molasses would be $121.33 per acre. Deducting, as in the case of the results obtained with the experiments with the small plots the cost of manufacturing the extra sugar and the depreciation, say $23.17, the net return from the seedling sugar canes in excess of the White Transparent would be $98.16 per acre. As on the average there were 103 acres of the seedling canes and 5.25 acres of the White Transparent grown per annum, the gain would have been, if the 108.25

acres had been planted with seedling sugar canes instead of the White Transparent, $10,626 per annum, or for the two years $21,252.

In addition to growing the new seedling sugar canes there are other lines of work which can be undertaken in connection with the sugar canes for the benefit of the industry. To give an instance, I may mention that in 1920 I started an experiment for the purpose of ascertaining whether it was not possible to increase the yield of the sugar canes per acre by growing them from stools containing the average maximum number of canes per stool. The next year I added to the experiments by growing cuttings in the manner usually adopted on the sugar estates, that is, taking cuttings from the stools as they come without regard to selection. Of course, it is too soon yet to make a definite statement in connection with this work, but the following table showing the results may be of interest. It will, however, be seen from the table that so far, on the average for the two years, the sugar canes grown from cuttings taken from the stools containing the maximum number of sugar canes, yielded 5.58 tons per acre, or 18.72 per cent. more than the sugar canes grown from the stools with the average number per stool, and that this year the canes obtained from the cuttings taken from the stools with the maximum number of canes have yielded 5.05 tons per acre, or 19.27 per cent. more than those grown from the minimum number per stool.

Mr. Shamel, who is the Physiologist of the United States Department of Agriculture says, "The writer is of opinion that systematic economic bud selection in the way of improved sugar canes will give particularly early and striking results in the way of improved sugar production per acre, which will be worth millions of dollars annually to the industry.

"The simple elimination through bud selection of the undesirable strains arising from bud mutations in the established varieties will in itself achieve this result. This work can be carried out without any possibility o loss to the industry or the rearrangement of any of the methods of culture, other than that of securing seed cane for planting. The cost of this work will be very small in comparison with its value. The increased production of sugar through the culture of uniform and superior varieties will be effected at no greater cost than that previously sustained when growing the more variable varieties with their resulting lower yields."

I entirely concur in Mr. Shamel's opinion in this matter.

The President: There is no question whatever that the introduction of the seedling canes has been of great value to Barbados where it was first taken up, and afterwa ds to other places, so that it has become a fundamental part in sugar production. We all know how much Mr. Bovell and Mr. John Harrison have done in this conconection.

"EXPERIMENTS RELATING TO SUGAR CANE IN JAMAICA."

BY

P. W. Murray, Superintendent of Agriculture, Jamaica.

The Sugar Industry of Jamaica ranks second in importance in the colony, and is only slightly surpassed in importance by the first industry, the banana, by a comparatively small amount. We have 55,000

acres of cane under cultivation with an output, exclusive of the sugar produced by the small settlers, of 50,600 tons, valued at £911,822, and a rum output of 809,023 gallons, valued at £80,903, making a total valuation of £992,725, just under one million pounds.

It is difficult to state an exact time when experimental work was started on Sugar canes in Jamaica. The Botanical Gardens at Hope, under the direction of Mr. William Fawcett, had for many years previous to the inauguration of the Sugar Experimental Station distributed to the estates of the island seedling canes, which had been introduced here from various parts of the cane growing world.

The Sugar Experiment Station of Jamaica was started under the administration of Sir Sydney Olivier in 1902 with funds granted by the Imperial Authorities.

Before going further into this subject, I should like to place on record before this Conference, the appreciation of the Department for the valued assistance and co-operation given us by the other West Indian Islands, and particularly so by Barbados and Demerara, in providing us with valuable literature and the best of their seedling Canes. I also express my gratitude for the ready assistance and co-operation accorded us by the Sugar Planters of this island. Among these I should like particularly to mention Messrs. Joseph Shore, George Taylor, Kelly Lawson, Kerr Jarrett, Edward Morris, Walter Morris, Lenny Thomas, Fred Clarke, Victor Michelin, Walter Farquharson, H. B. Walcott, Ernest Straumaun, Fred Ellis, A. E. Muschett, P. A. Bovell, Caryll, Bertie Milliner, and Dr. Grinan.

One of the important branches of the work undertaken by the Experimental Station has been research work on the Sugar Cane to determine, first the value of seedlings and other varieties of canes and the propagation of new varieties from Seed, and secondly, the value of artificial manure and other manures on the Sugar Estates of the island.

Varietal Selection.—It was first necessary to establish some standard by which we might judge the relative value of the canes, and we selected the White Transparent cane, generally grown throughout the island. A ruthless system of eradication was adopted by which all seedling canes, some hundred odd varieties in number, then growing in different parts of the island, should be compared. Any cane which did not give as a plant and a ratoon as good results as the White Transparent was abandoned. The result of this test indicated that the Botanical Gardens had been distributing a great number of Canes, which though valuable in other parts of the world, were only valuable as Botanical specimens to us, as we had in the White Transparent a far better cane for our conditions.

Experimental plots were started on various Estates in different centres of the island, some twenty in number, and those varieties which gave promise of having any inherent quality equal to that of the White Transparent were there planted, with the White Transparent alongside for comparative tests. The results indicated that as plant canes under average conditions of rainfall and soil the seedling canes had no equal, giving greater tonnage and juice of a higher sugar content. The B 208, the D 625 and the J 72 excelled all others. More extensive plots were then planted and the varieties which had done best extended. Nurseries were started in the West and in central sections of the island in addition to the parent Nursery at Hope Gardens, where large areas were planted for propagation of tops from these varieties.

For a time the Seedling Cane was most popular. Then gradually one Estate and then another returned to the White Transparent, as the seedling canes did not over a period of years with the vicissitudes of drought, poor cultivation, and in many cases lack of cultivation of ratoons, due to shortness of labour and funds, stand up to these adverse conditions as did the White Transparent.

It is a matter of regret that I have to state that with the exception of the B H 1012, and the Uba Cane, we have not found by actual field tests a cane which so well suits the Estate conditions in Jamaica as does the White Transparent.

I should welcome most heartily any assistance that any Member of this Conference may give me in solving this problem of varietal canes in Jamaica. I am perfectly satisfied that a better cane than the White Transparent is possible and desirable, that methods of cultivation can be improved, and that a better return of sugar per acre should be obtained than we at present attain, but the hard fact remains, that the seedling canes that we have so far tested have not proved to be in Jamaica the success that they have been in other West Indian Islands.

Mosaic Disease.

Another most important point in this connection, is that we have found that the Seedling Canes are not immune to Mosaic Disease, and in many cases are much more susceptible to the Disease and suffer more from it than does the White Transparent. I except from this Statement the B. H. 1012, and other recently imported canes from Barbados, for though I have seen the B. H. 1012 attacked with Mosaic Disease, I have not yet been able to determine its resistant qualities. The resistance of Seedling Canes to disease, and the absolute necessity of having a resistant Cane still further narrows the margin of our selection.

Realising the importance of Seedling Canes to the Sugar Industry and the fact that so far we had not yet imported or produced a superior cane to the White Transparent under the present conditions of rainfall and cultivation in Jamaica, the Director of Agriculture advised the Government to secure the services of an expert on this subject, and naturally we turned to Mr. J. R. Bovell of Barbados, whose work has been an inspiration and help to us, and asked his assistance in the selection of such an Officer. Mr. M. S. Goodman, his able assistant who had worked with him for years was sent us. I am pleased to record that Mr. Goodman has rendered valuable services to our Department, and we have now growing at Hope, seedlings produced not only from the White Transparent and other canes, but also from the Uba Cane, which latter seedlings we confidently expect will be either entirely immune, or highly resistant, to Mosaic Disease.

This burning question of Mosaic Disease has naturally influenced and changed our view point with regard to the entire question of varietal Canes, for unless a cane is fairly resistant to this disease, it is of no use to us at the present time.

Uba Canes.

It is providential that in 1916 the present Lord Kitchener, who was for many years resident in this island, should have drawn the attention of Mr. Cousins, the Director of Agriculture to the Uba Cane

growing in Africa while on one of his visits to that country. The late Mr. William Harris, secured through his son-in-law, Mr. Thornley Stewart, a consignment of three tops from his plantations in Africa. The ship on which these tops were being conveyed to England was torpedoed and the mail subsequently salvaged and the tops planted at Hope. Of the three which arrived only one grew. From this single top we now have in Jamaica over two thousand acres of Uba Cane,—which from its many good points, the principal of which is its immunity to Mosaic Disease, is destined to play an increasingly important part in our Sugar industry.

This Cane has on nearly every estate proved to be a valuable Cane as a drought resister, and gives in many cases double the tonnage of the White Transparent, with considerable less cost of cultivation on poor soils. There is to-day not an Estate in the Island which has not a Uba plot, and in many cases the cultivation runs up into hundreds of acres. The Sugar content is not as good as that of the White Transparent in many centres, nor is the juice content as high, but the excess tonnage secured more than compensates for these deficiences. It has been put forward by Planters that the Uba does not ripen under seventeen months as plants, but other Planters state that this statement is equally true of the White Transparent, as only from fall plants do they expect to cut fully ripe canes.

BH 1012 is now, and justly so, the popular seedling in Jamaica. Our Department has nurseries at Hope and in five other centres of the Island, varying in size from three to twenty acres where this cane is being propagated as quickly as possible for distribution. Two large Estates have secured direct from Barbados tops of this variety and are willing to sell tops in quantity to any estate wanting them.

Manurial Experiments.

These experiments have been conducted for many years on the Estates of the island, and we have come to the following conclusions :—

1. Phosphates are unnecessary and do not repay the cost of application.
2. Nitrate of Soda or Sulphate of Ammonia with an addition of Potash in the proportion of two to one is reliable and will, when favourable Seasons prevail, give a handsome return on the investment.
3. That lime is necessary on most of our soils and will repay the expenses of application, giving generally a very profitable return.
4. That the repeated application of Sulphate of Ammonia year after year, does not result in an increased tonnage, but that Nitrate of Soda will continue to give good results for a period of years.
5. That the beneficial result from the use of artificial manures is dependent on adequate rainfall, and is in drought areas a risky venture.

I am pleased to say that I believe a new era is dawning in the Sugar industry of Jamaica, in that Planters have realized that Sugar is not made in the Factory but in the field, and there are indications that a more intensive method of cultivation and manuring is materializing, and with the help of the BH 1012, the disease resisting seedlings and the awakening brought about by this Conference in matters agricultural, I look forward with confidence to the future of the Jamaica Sugar industry.

Mr. Nowell said as regards the seedlings of the Uba Cane, he would like a little more definite information on the subject as to what is being done in Jamaica.

Mr. Cousins: We have had much difficulty in getting the arrows of this cane but Mr. Goodman was successful in raising a cross bred seedling of the Uba cane and we think it will grow as a useful half breed cane that will resist disease.

"EXPERIMENTS ON SUGAR CANE IN TRINIDAD."

BY

J. Verteuil, F.I.C., Agricultural Chemist.

(Communicated by Mr. Nowell.)

Although it is barely more than five years since the first new Trinidad seedlings were raised in 1919, results have been obtained during the past three years, on small plots of 1/80 to 1/20 of an acre, from nine of the seedlings raised during the 1917 flowering season. Three of these, viz:—T. 487, and T. 496 and T. 499 have given consistently good results grown in competition with B. 156, Ba. 6032 and B. H. 10 (12) in the same fields and under identical cultural conditions. It is suggested that cuttings might be offered to Planters for a trial on a small scale.

The following are the comparative results obtained:—

Comparison of Trinidad Seedlings raised in 1917 with B 156, Ba. 6032 and B. H. 10 (12).

Cane.	Plant Canes. Average for 3 years 1921-23.			First Ratoons. Average for 2 years 1922-23.		
	Sucrose in Juice: per gallon	Canes	Sucrose in Juice: per acre	Sucrose in Juice: per gallon.	Canes.	Sucrose in Juice: per acre
	lb.	Tons.	Tons.	lb.	Tons.	Tons.
T. 487	1.967	32.76	3.86	2.279	21.46	2.85
T. 496	1.908	30.82	3.72	2.002	24.15	2.93
T. 499	1.547	30.55	3.06	1.854	32.49	3.88
B.H. 10 (12)	1.870	28.59	3.29	1.937	30.17	3.50
Ba. 6032.	1.558	29.65	2.82	1.687	30.16	3.09
B. 156	1.663	31.37	3.21	1.724	22.41	2.29

Cane.	Second Ratoons. 1923.			Average for plant canes, First and Second Ratoons
	Sucrose in Juice: per gallon.	Canes.	Sucrose in Juice: per acre.	Sucrose in Juice: per acre
	lb.	Tons.	Tons.	Tons.
T. 487	2.277	22.13	3.02	3.37
T. 496	2.162	22.98	3.11	3.36
T. 499	1.839	23.63	2.79	3.29
B.H. 10 (12)	1.989	18.56	2.21	3.18
Ba. 6032	1.833	19.98	2.15	2.80
B. 156	2.042	18.09	2.10	2.72

The three varieties have given slightly better results than B.H. 10 (12) and they show approximately half a ton more of indicated sucrose in the juice per acre per annum than either Ba. 6032 or B. 156.

T. 487 is a purplish cane of good size somewhat resembling the Badilla. It is a cross between B. 208 and D. 625.

T. 496 is a medium cane about the size of B. 156 and was raised from the Bourbon.

T. 499 was also raised from the Bourbon and it is a good size cane.

Another variety T. 301, raised from the Bourbon in 1917 has given even better results than any of the above, viz:—3.84 tons of indicated sucrose per acre. This case, however, is very susceptible to die back as it reaches maturity.

Results from the seedlings raised in 1918 have also been obtained on small plots of 1/40 to 1/20th of an acre for 1922 and 1923, as plant canes, and for 1923, as first ratoons. Good results have been obtained from at least twelve of these but at this early stage it is suggested that only T. 519, T. 617 and T. 718 be offered to Planters for trial on a small scale.

The results of these three varieties compared with B. 156, Ba. 6032 and B.H. 10 (12) grown under identical conditions are given below :—

Comparison of Trinidad Seedlings raised in 1918 with B. 156, Ba. 6032 and B.H. 10 (12.)

Cane.	Plant Canes. Average for 2 years, 1922-23.			First Ratoons 1923.			Average for plant canes and first Ratoons.
	Sucrose in juice per gallon.	Per acre Canes.	Per acre Sucrose in Juice.	Sucrose in juice per gallon.	Per acre Canes.	Sucrose in juice per acre	Sucrose in Juice.
	lb.	Tons.	Tons.	lb.	Tons.	Tons.	Tons.
B.H. 10 (12)	1.916	35.02	4.05	2.011	36.63	4.58	4.23
T. 718	2.003	38.65	4.61	1.958	25.24	2.93	4.05
T. 519	1.815	36.25	4.02	1.865	31.90	3.65	3.90
T. 617	1.893	33.49	3.94	1.839	30.69	3.64	3.84
B. 156	1.603	38.48	3.85	1.922	16.33	1.96	3.22
Ba. 6032	1.618	38.73	3.65	1.599	17.83	1.75	3.02

From the above table, it will be seen that B.H. 10 (12) has given better results than the seedlings and this is due to the unusually high yield obtained from the ratoons. These three seedlings however, viz. T. 718, T. 519, T. 617 show at least half a ton more indicated sugar per acre per annum than either B. 156 or Ba. 6032.

T. 718 is a medium size cane of upright growth and was raised from H. 146.

T. 519 is a fair size cane of upright growth and was raised from H.

T 617. was raised from L. 511 and is a good size cane.

Cane.	Season.	Tons of canes per acre.	Increase in tons per acre over average stools.	Increase in tons per acre over small stools.	Per cent. increase.	
					Average stools.	Small stools.
Canes selected from large stools of B H. 10 (12).	1920-22	27.12				
Canes selected from large stools of B.H. 10 (12)	1921-23	35.39	5.58		(a) 18.72	
Mean	..	31.26		5.05		(b) 19.27
Canes selected from average stools of B.H. 10 (12)	1921-23	29.81				
Canes selected from small stools of B H. 10 (12)	1920-22	24.19				
Canes selected from small stools of B.H. 10 (12)	1921-23	28.23	..	..	..	..
Mean	..	26.21	..	..	..	..

(a) For one year.
(b) For two years.

Since the above work was started, I have received from the Experimen Station of the Hawaiian Sugar Planters' Association a paper which was presented by Mr. A. D. Shamel to the members of the Social Science Association of Honolulu on March 7, 1921.

It is perhaps worthy of note that the experience in Trinidad has been that certain canes have continued to be successful there, which had been completely forgotten in the island of their origin. Particularly is that the case of B. 156. Now in Trinidad B. 156 has not only persisted, but what is still more remarkable is that it has suffered very little from deterioration. In Barbados, there has been a continued succession of new canes, each of which has been better than the old one. As a matter of fact, what happens is that the seedling cane when it is produced is better than the preceding seedling cane at the stage at which it had then reached. The real thing about B. 156 in Trinidad is that even up to now, it can hold its own and improve upon the yield of even the latest results from Mr. Bovell's fields. Another point which is of general interest is that certain canes are very much superior to the rest as parents. We have raised dozens and dozens of seedlings of which 99% have been rejected and we find that it is best to raise only specially selected canes which have come from good parents. In Trinidad, our system is to compare them in comparative plots in comparison with the B.H. 10, 12, and 13 and H. 1032 and also with B. 156, which may be regarded as the standard canes of Trinidad. The results of our seedlings at the experimental station can be stated in general terms as being slightly better in some cases than those three varieties.

Mr. Bovell: With regard to deterioration in Barbados, we have taken certain varieties of canes and compared them with the White Transparent and the percentage has been the same showing than no deterioration has taken place.

TICK DESTRUCTION IN JAMAICA

BY

H. H. Cousins, M.A., Director of Agriculture.

About 30 years ago, the tick problem in Jamaica had become acute and due to the unfortunate introduction of cheap beef cattle from Central America, which took place at that time, the parasite of Texan Fever became widely distributed among the herds in the island.

Herds of well-bred Hereford and other types of English cattle that had prospered for years in Jamaica became affected with Tick Fever and a very heavy mortality of cattle resulted.

An Expert from England was requisitioned by the Government and in 1896 Professor Williams came out and diagnosed the cattle disease as "Tick Fever."

In order to control the ticks, Professor Williams recommended the smearing of the animals with a mixture of tar and oils. When applied in a comprehensive manner to a cow, this mixture stopped the pores of the skin and caused the poor animal to suffer from asphyxiation.

It was then found that the "tar and oil" mixture could only be applied with discretion and to a limited area of the skin of the cattle.

Under this system, some relief to the cattle was affected, but the grazing pens of Jamaica became so terribly infected with ticks that life on a pen became a constant battle with the irritating ticks.

Certain breeders then discovered the natural resistance of Zebu cattle to the tick pest and a widespread mingling of Indian blood was resorted to, in order to reduce the susceptibility of the cattle to the ticks.

The effect of this cross-breeding was truly remarkable and the Zebu blood enabled Jamaica successfully to cope with the blood-parasite of tick-fever and to breed cattle that were largely resistant to gross tick infestation.

The economic effect, however, was to reduce the quality of beef and to produce excitable cattle which were ar more difficult to handle than the old-fashioned cattle of Jamaica which were largely of European blood.

In 1908, the writer became personally involved in the tick-question by finding the pasture attached to the Director's residence at Hope, terribly infected with ticks, and his interest was urgently aroused in the study of the problem of tick-destruction in Jamaica. The mission of Professor R. Newstead, F.R.S., the distinguished Entomologist of the Liverpool School of Tropical Medicine, fortunately occurred at the time. Professor Newstead in a few short weeks in 1909, grappled with the tick situation in Jamaica and in co-operation with the Director at Hope carried out experiments which have directly led to the quite remarkable result which it is now proposed to describe.

If Professor Newstead were to return to Jamaica to-day and to re-visit the places where he studied the tick-pest 15 years ago, he would be gratified to see the beneficial revolution which has been brought about directly as a result of the three months he spent in Jamaica in 1909 for the special purpose of throwing light on the problems of the tick pest in Jamaica.

The first experiments made were in the direction of "spraying" the infected animals. All the commercial preparations then available were tested but were found not to be quite satisfactory in use. A trial was then made of "Paranaph," a Paraffin-naphthalene emulsion invented

by the writer in England in 1895. This produc had been found a success in Kent for spraying Hops infected with aphis. When reinforced with Arsenic, Professor Newstead pronounced it successful for tick-destruction in Jamaica.

It soon became la gely used and the Department introduced an other Kentish invention, the "Abol" spraying syringe, whereby cattle could be effectively sprayed by hand with a suitable dip containing Paranaph and Arsenic.

Exper nce showed, however, that the human element made spraying unreliable. A few ticks occasionally escaped destruction and as these propagated 2,000 more ticks for every female tick that survived the spraying, it became apparent that with spraying the tick would be always wi h us. Encouraging information about dipping tanks was obtained from the Director of Agriculture in South Africa in 1914 and in 1915, under the personal supervision of the newly appointed Entomologist, Mr. A. H. Ritchie, the first dipping tank in Jamaica was constructed at Hope at the modest cost of £25. This tank was a small vat of less than 1,200 gallons capacity as used by the United Stat s Department in its tick campaign in the Southern States. Constructionally, this tank was defective for general use in Jamaica. It was too narrow for wide-horned beasts. It was too short for athletic Zebu-cattle that go in with a bold, long jump. It overflowed badly when used at high pressure for a large herd and drainage and absorption pits had to be constructed at extra cost to render the Hope dipping tank f ee f om danger.

As regards the dip, the first prescription of the writer

(3 lbs. Paranaph)
(2 lbs. Arsenite of Soda, 80%)

per 100 gallon dip has been found after 9 years' experience to be about the best strength for general use in Jamaica and is the strength generally advised by the Department. A destruction of 100% of ticks without burning the skin of the cattle is thereby effected. The emulsion of the Paranaph has been found to be permanent and the dip has been kept in tanks in use for over a year without any separation of the Kerosene from the emulsion. Encouraged by this experience various progressive cattle breeders installed dipping tanks on their properties and in 1920, the Legislative Council took the bold step of enacting Law 41 of 1920, entitled The Tick (Control and Eradication) Law, 1920, (Law 41 of 1920). (*Appendix A*)

This Law gives power to the Governor in Privy Council "to make Orders for the periodical treatment of cattle by effective dipping or by the use of some other means for the control and eradication of ticks" and provides the necessary machinery and compulsory powers to enable this to be carried out. The fines are fixed at a maximum of £50 for a first offence and £500 or six months' imprisonment for a second or subsequent offence.

Owing to drought conditions and the very high cost of cement, some delay arose before action was taken under the new law. An "Order" calling for the construction of dipping tanks by all owners of more than 100 head of cattle was issued with affect from 1st January, 1923, and from 1st September, 1923, an "Order" was issued making dipping compulsory under certain regulations. (*Appendix B*).

The Laboratory issues to the public the Paranaph and Arsenite of Soda required for use in the dipping tanks.

In 1923, 25 tons of Paranaph for the supply of almost one million of gallons of dip was thus supplied.

As the Department Dip costs about one-third as much as the most successful commercial preparation nearly every tank in the island is now supplied from the Laboratory. It is estimated that this service saved the penkeepers £2,300 during the past year.

In order to keep the Arsenic up to strength "Testing outfits" are supplied and chemicals and standard solution of Iodine are issued regularly to our clients. The Testing Tables supplied show the actual amount of Arsenite of Soda (80% in the tank and the amount required to bring the strength to standard.

It is gratifying to find how efficiently most of the cattle owners in Jamaica have shown themselves in testing their dipping liquid and keeping the tanks at the correct standard. Some explanatory literature is furnished as Appendix C.

The effect of this campaign against ticks has been to increase the production of cattle by almost 25 per cent and to reduce to negligible proportions the losses from death which formerly occurred to a serious extent when drought conditions had to be faced on the cattle pens and Sugar Estates.

It is now feasible to use a much higher proportion of specialised beef and dairy blood in our cattle and thus to increase the efficiency of our herds in Jamaica.

Appendix A.

JAMAICA.

No. 41—1920.

I assent,

L. PROBYN,
Governor.
31st August, 1920.

A LAW to make provision for the control and eradication of ticks among cattle.

[31*st August*, 1920.]

BE it enacted by the Governor and Legislative Council of Jamaica, as follows:—

1—This Law may be cited as the Tick (Control and Eradication) Law, 1920.

2—In this Law, the following expressions have the meanings herein assigned to them:—"Cattle" means horses mares, geldings, colts, fillies, mules, asses, bulls, cows, oxen, heifers and calves.

"Owner" means the person for the time being receiving the rent of the premises in connection with which the word is used, whether on his own account or as agent or trustee for any other person or who would so receive the same if the premises were let.

'Construct" includes repair.

"Holding" means any lands in possession or occupation of any person as owner or occupier and on which cattle are kept.

3—(1) The Governor in Privy Council may make such orders, as he may think fit for prescribing, regulating and securing the periodical treatment of all or any cattle by effective dipping or by the use of some other means for the control and eradication of ticks and any such order may be made to apply to the whole Island or to any area defined in the order. By these orders different means may be prescribed for different areas.

(2) The Governor in Privy Council may by the same or any other Order as he may think fit direct that the owners or occupiers of holdings on which there shall be cattle shall construct dipping tanks sufficient for the effective dipping of all cattle on the said holdings and it shall be the duty of such owners or occupiers to construct dipping tanks accordingly.

(3) Any such order may prohibit the removal of cattle from any pen, estate or area named or defined in the order.

(4) Any order made for the purposes of this Law may be added to varied or revoked by a subsequent order made by the Governor in Privy Council.

(5) Any order made for the purposes of this Law shall be published in The Jamaica Gazette and shall come into operation on such publication or at such other time as may be named in such order.

4—Any expenses reasonably incurred by the occupier of any holding in constructing a dipping-tank shall in the absence of an agreement to the contrary between such occupier and the owner of such holding be recoverable by the occupier from the owner of such holding as money paid at his request, or may be deducted from the rent as the same falls due: provided that where the owner is not bound to construct a dipping tank and is under the provisions of this Law put to expense in constructing a dipping-tank or of repaying the cost of such construction as aforesaid the occupier if he be a tenant shall in addition to the rent otherwise payable during his tenancy pay a further rent equivalent to ten per centum, per annum on the amount paid by the owner: provided that no tenant shall have any rights against the owner under the provisions of this section unless he has given to the owner personally, or by registered letter,30 days notice, in writing of any order directing the construction of dipping tanks.

5—It shall be lawful for the Governor to appoint persons to carry out the provisions of any order made for the purposes of this Law and any person so appointed may with such assistance as may be necessary enter upon any land and there examine any cattle in order to ascertain whether such cattle are free from ticks or whether any order made for the purposes of this Law has not been or is not being complied with.

6—If any person without lawful authority or excuse, proof whereof shall lie on him, does any of the following things he shall be guilty of an offence against this Law.

(1) If he does anything in contravention of any order made for the purposes of this Law or fails to carry out any measures required to be carried out by him under any such order.

(2) If he refuses to any person admission to any land, or place which the said person is entitled to enter or obstructs or impedes such person in so entering or in examination of any cattle or otherwise in any way obstructs or impedes any person in the execution of his duty under this Law or assist in any such obstructing or impeding, and he shall on summary conviction before a Resident Magistrate be liable to a fine not exceeding Fifty pounds and in default of payment to imprisonment with or without hard labour for any period not exceeding three months and on a further conviction within a period of twelve months for a second or subsequent offence against this Law, he shall be liable in the discretion of the Court in a fine not exceeding Five Hundred Pounds and in default of payment, to be imprisoned for any term not exceeding six months with or without hard labour in lieu of a fine to which he is liable.

7—It shall be lawful for the Governor to cause to be constructed from funds provided for the purpose by the Legislative Council such public dipping tanks as he may consider to be necessary for the purposes of this Law and with the consent of any owner of a dipping tank, to declare by notice in the Jamaica Gazette such dipping tank to be a public dipping tank for the purposes of this Law, and the Governor in Privy Council may by orders made under section three of this Law regulate the use and management of public dipping tanks and fix the charges payable by the owners of cattle which are dipped in any public dipping tank and such charges shall be recoverable by the Director of Agriculture as a civil debt.

8—No prosecution for an offence against this Law shall be instituted except by or with the consent of the Director of Agriculture.

9—All process under this Law shall be free.

Appendix B.

COPY.

The Jamaica Gazette, October 19, 1922.

No. 603. 18th October, 1922.

WITH reference to Government Notice, No. 252, dated the 10th of May, 1922, the following order made by the Acting Governor in Privy Council under Section 3 of Law 41 of 1920 "The Tick (Control and Eradiction) Law, 1920" is hereby published for general information.

By command,
(Sgd.) D. H. HALL,
Acting Colonial Secretary.

THE TICK (CONTROL AND ERADICATION) (DIPPING TANKS) ORDER, 1922.

WHEREAS by section 3 of "The Tick (Control and Eradication) Law 1920" (Law 41 of 1920) it is (among other things) enacted that the Governor in Privy Council may make such Orders as he may think fit for prescribing, regulating and securing the periodical treatment of all or any Cattle by effective dipping for the control and eradication of Ticks and any such Order may be made to apply to the whole Island or to any area defined in the Order, and that the Governor in Privy Council may by the same or any other Order as he may think fit direct that the

Owners or Occupiers of holdings on which there shall be Cattle shall construct dipping tanks sufficient for the effective dipping of all Cattle on the said holdings and it shall be the duty of such Owners or Occupiers to construct Dipping Tanks accordingly, and that any Order made for the purposes of the Law shall be published in the Jamaica Gazette and shall come into operation on such publication or at such other time as may be named in such Order.

Now, therefore, I, The Honourable Brevet-Colonel Herbert Bryan, Companion of the Most Distinguished Order of Saint Michael and Saint George, Companion of The Distinguished Service Order, Acting Governor in and over the Island of Jamaica and its Dependencies, by and with the advice of my Privy Council, in exercise of the aforesaid powers conferred by "The Tick (Control and Eradication) Law 1920" (Law 41 of 1920) and of all other powers in that behalf hereunto enabling do hereby order and it is hereby ordered as follows:

1. The Owner or Occupier of any holding, on which there shall be at any time Cattle of or exceeding the number of One Hundred, shall, for the control and eradication of Ticks, construct or cause to be constructed a Dipping Tank on the said holding sufficient for the effective dipping of all Cattle on the said holding, and the construction of every Dipping Tank shall be completed on or before the 1st day of January, 1923:— Provided nevertheless, that where two or more of such holdings are in the possession or occupation of the same Owner or Occupier and shall not be more than Three Miles apart from one another along any Road, passage or way on which Cattle can be led or driven, the construction by such Owner or Occupier of a Dipping Tank, for the purpose aforesaid, and within the time aforesaid, on any one of such holdings, shall be deemed to be a sufficient compliance by such Owner or Occupier with the provisions of this Order: And provided also that where two or more of such holdings are in the possession or occupation of different Owners or Occupiers and shall not be more than three miles apart from one another along any road, passage or way on which cattle can be led, the different owners or occupiers shall, subject to and with the consent and approval of the Director of Agriculture, agree among themselves in writing that a Dipping Tank, for the purpose aforesaid, and within the time aforesaid, shall be constructed by one of such Owners or Occupiers on any of such holdings, and when constructed that such Dipping Tank shall at all times be available for Dipping the Cattle of the Owners or Occupiers of such other holdings, as well as the Cattle of the Owner or Occupier of the holding on which such Dipping Tank shall be constructed, then and in such case, the construction of such Dipping Tank on any of such holdings shall be deemed to be a sufficient compliance by the respective Owners or Occupiers of such holdings with the provisions of his Order.

2. Every Dipping Tank under this Order shall be constructed, subject to the approval from time to time during such construction of the Director of Agriculture; and on the Director of Agriculture giving notice in writing to any Owner or Occupier of any holding as aforesaid of his disapproval, in any respect, of the construction of such Dipping Tank and requiring such defects to be remedied, to the satisfaction of the Director of Agriculture, all such defects in construction as shall be specified in such notice, to be completed within four months from the service of such notice.

3. This Order shall apply to the whole Island and shall come into operation immediately on the publication of the same in the Jamaica Gazette.

4. In this Order, the expression "Cattle," "Owner," "Construct," and "Holding," shall have the same meaning, respectively, assigned to these expressions by Section 2 of "The Tick (Control and Eradication) Law 1920" (Law 41 of 1920).

5. The Interpretation Law 1900 (Law 9 of 1900) shall, for the purpose of the interpretation of this Order, apply in like manner as it applies for the purpose of the interpretation of a Law.

6. This Order may be cited as "The Tick (Control and Eradication) (Dipping Tanks) Order 1922".

Made by the Acting Governor in Privy Council this third day of October, 1922.

(Sgd.) H. Bryan,
Acting Governor.

Appendix B.

The Tick (Control and Eradication) (Dipping Tanks) Order, 1923.

Whereas by Section 3 of "The Tick (Control and Eradication) Law, 1920" (Law 41 of 1920) it is (among other things) enacted that the Governor in Privy Council may make such orders as he may think fit for prescribing, regulating and securing the periodical treatment of all or any cattle by effective dipping for the control and eradication of Ticks and any such order may be made to apply to the whole island or to any area defined in the order.

Now, therefore, I, Sir Leslie Probyn, Knight Commander of The Most Distinguished Order of Saint Michael and Saint George, Captain General and Governor-in-Chief in and over the Island of Jamaica and its Dependencies, by and with the advice of my Privy Council, in exercise of the aforesaid powers conferred by The "Tick (Control and Eradication) Law, 1920" (Law 41 of 1920) and of all other powers in that behalf hereunto enabling do hereby order and it is hereby ordered as follows:—

1. On and after the 1st day of September, 1923, all cattle in the Island shall be dipped in a dipping tank registered with the Department of Agriculture in accordance with the Order for the construction of dipping tanks. (The Tick) (Control and Eradication) (Dipping Tanks Order 1922) of the 3rd October, 1922, and published in the Jamaica Gazette of the 19th October, 1922, and furnished or charged with a "dipping" liquid containing not less than 2 lbs. and not more than $2\frac{1}{2}$ lbs. of Arsenious Oxide in 100 gallons of the liquid and the dipping aforesaid shall be made at intervals of not more than two weeks between each dipping, unless the Director of Agriculture gives written permission for a longer interval for the reason that as a result of previous dippings the cattle of an owner no longer need to be dipped as frequently as every two weeks.

2. An Inspector is empowered to order the dipping of cattle at shorter intervals than two weeks but not oftener than once a week. The Inspector is also authorised to relax this rule and of Rule 1 supra in any case where he considers it to be justified.

3. Any owner of a dipping tank who through drought and lack of water, is unable to dip his cattle shall apply for a certificate of Temporary Exemption from the Director of Agriculture who shall grant this if he is satisfied that the owner is really unable to obtain water for dipping his cattle. Such certificate of exemption shall free the owner from the

requirements of these rules until such time as the lack of water and drought shall have ceased.

4. These rules shall not apply to any owner of cattle who can prove that he has been unable to obtain access to a dipping tank situated within two miles walking distance of his holding and, having less than 100 head of cattle, is not called upon himself to construct a dipping tank.

5. This order may be cited as "The Tick (Control and Eradication) (Dipping Tanks) Order, 1923."

Made by the Governor in Privy Council this tenth day of July, 1923.

L. PROBYN,
Governor.

Appendix C.—Tick Destruction.

PARANAPH AND ARSENIC WASH.

The most economical and effective source of Arsenic for adding to Paranaph for the destruction of ticks on Cattle is Commercial Arsenite of Soda 80%. This is now supplied by the Department at 8d. per lb., in bulk, or in tins, each holding 8 ounces, at 6d. per tin.

Instructions for use.

WARNING.—*Arsenite of Soda is a dangerous poison and must be carefully guarded under lock and key and kept in a receptacle marked "Poison."*

A.—*Standard Wash for use as a Spray:—*

1. Arsenite of Soda	1 ounce
2. Paranaph	2 quarts or 5 pounds
3. Water	12 quarts.

Dissolve half a pound of Arsenite of Soda (the contents of small tin as issued by the Department) in 2 quarts of water. Cold water will suffice if some hours are allowed for the powder to dissolve. Shake or stir at intervals. Some undissolved sediment will always remain. Store this solution of Arsenite of Soda as "*Stock Solution of Arsenite of Soda.*"

For every mixing of Paranaph at the rate of 2 quarts or 5 lbs. of Paranaph in 12 quarts of water add one condensed milk tin (1 lb. size) full or filled to within half an inch of the rim with the "Stock Solution of Arsenite of Soda" as described above. This quantity contains 1 ounce of Arsenite of Soda.

B.—*Commercial Wash for use as a Spray (economical).*

1. Arsenite of Soda	$3\frac{1}{2}$ ounces.
2. Paranaph	1 pound.
3. Water	10 gallons

Dissolve the Paranaph in the water and add $3\frac{1}{2}$ ounces of Arsenite of Soda or $3\frac{1}{2}$ condensed milk tins full of "Stock Solution of Arsenite of Soda." Use tank or rain water if procurable.

C.—*Dip for use in Dipping Tanks.—*

1. Arsenite of Soda	2 lbs.
2. Paranaph	3 lbs.
3. Water	100 gallons

EXPLANATORY NOTES.

Formula A. is the most efficient Spray for cattle yet tested at the Government Farm at Hope. It is somewhat expensive owing to the large amount of Paranaph. Where long-haired stock have to be dealt with a large proportion of Paranaph is required.

Formula B. is a cheaper formula for the control of ticks by spraying

where expense is a consideration. It is not so efficient as A. but kills ticks very well for practical purposes of control.

Formula C. is the standard Departmental liquid for use in Dipping Tanks and has been found highly efficient.

Directions for Testing Dipping Fluids.

1. Thoroughly stir liquid in Tank.
2. Take 25 cubic centimetres (c.c.) of the stirred liquid, carefully measuring this quantity in the graduated cylinder supplied with the testing outfit.
3. Pour the measured quantity of dip into the wide-mouthed bottle.
4. Add as much Sodium Bicarbonate as will hold on a farthing piece, shaking well to allow it to dissolve in the sample of dip.
5. Add a teaspoonfull of Starch Solution. Shake.
6. Fill graduated cylinder to the 25 c.c. mark with Standard Iodine.
7. Pour the Iodine from the graduated cylinder into the dip to be tested, adding a small quantity at a time and shaking the mixture between each addition. Continue the foregoing procedure until a permanent blue colour is just attained. Avoid excess.
8. Inspect the graduated cylinder and note the number of cubic centimetres (c.c.) of Standard Iodine which has been used.
9. Consult the Testing Table which will show for each c.c. of Standard Iodine used the quantity of Arsenite of Soda in the tank and the quantity which requires to be added thereto.

Specimen Testing Table.

Registered Tank No......

Testing Table for Dipping Tank at.....

Owner.....

Capacity 1,800 gallons.

Standard Strength 36 lbs. Arsenite of Soda.
54 lbs. Paranaph.

Standard Iodine.	Arsenite of Soda in Tank.	Arsenite of Soda required for Tank.
5 c.c.	9 lbs.	27 lbs.
10 "	18 "	18 "
11 "	20 "	16 "
12 "	22 "	14 "
13 "	23 "	13 "
14 "	25 "	11 "
15 "	27 "	9 "
16 "	29 "	7 "
17 "	31 "	5 "
18 "	32 "	4 "
19 "	34 "	2 "
20 "	36 "	nil
		Excess Arsenite of Soda in Tank.
21 "	38 "	2 lbs.
22 "	40 "	4 "
23 "	41 "	5 "
24 "	43 "	7 "
25 "	45 "	9 "

(Sgd.) H. H. Cousins,
Director of Agriculture.

Date.....

Instructions for Treatment of Stock in Cases of Arsenical Poisoning.

1. Cattle affected Internally from the Effects of Drinking or Licking an Excessive Proportion of Wash Containing Arsenic (Cooper's Dip or other Dips containing Arsenic).

Symptoms.—Salivation or dribbling at the mouth. Dullness followed by uneasiness indicating abdominal pain generally within 6 hours of the taking of the poison. Other symptoms are prostration, staggering gait accompanied by painful groaning and watery discharge from the bowels.

Treatment.—If discovered within six to nine hours an antidote consisting of one ounce desiccated Magnesia dissolved in one pint of water should be administered every two hours until three doses have been given. Half an ounce of Sulphate of Iron dissolved in a quart of water is also a good remedy.

To alleviate the pain administer ½ ounce of Laudanum in a pint of water every six hours until three doses have been given. The white of 2 eggs can be usefully added to each dose of the Laudanum.

The animals should be kept warm and dry and not exposed to the sun.

2. Cattle Suffering from the Excessive External Application of Arsenic (Cooper's Dip or other Dips Containing Arsenic).

Symptoms.—A slightly hunched-up appearance with a quivering of the muscles of the hind legs, flanks and lower shoulder. Depression soon sets in, the animal shows uneasiness and lies down.

Treatment.—As soon as there is any reason to suspect that an animal has received an excessive external application of Arsenic from a careless use of Cooper's Dip or other dips containing Arsenic immediate action should be taken as delay may prevent successful treatment.

Wash the animal repeatedly, preferably with warm water, using a body brush to assist the removal of the Arsenical powder from the skin and hair.

If the animal is in a serious state of depression, stimulants consisting of half a pint of rum in water should be administered at intervals of four hours.

H. H. Cousins,
Director of Agriculture and Island Chemist.

Department of Agriculture,
Hope, 16.6.22.

Data Respecting Tick Destruction Service Department of Science and Agriculture

Number of Registered Dipping Tanks (to 21.1.24)	229
Paranaph sold during year 1923	14.1 tons
Arsenite of Soda sold during year 1923	8.7 tons
Standard Iodine Solution sold during year 1923	3.9 gallons

We spend £120,000 per annum in purchasing condensed milk that is made abroad. Those of you who visited Hope Farm this morning tasted the first fruits of our little condensed milk factory and we can make condensed milk in Jamaica which is better than the condensed milk we get into the island from abroad to day. That means that we can produce more condensed milk in Jamaica at a cheaper rate than the foreign article can be bought in the island. The

business world may be alarmed but there are firms in Kingston who are making fabulous amounts on the condensed milk that is imported into Jamaica. It would be an easy matter to get 12,000 quarts of milk per day and the Railway would charge say ¼d. per quart for each quart of milk transported. I feel sure that those business men in Jamaica who have been alarmed at this proposition—and the "Daily Gleaner" has also been alarmed those business men who handle the foreign article will also handle our own native product under the same conditions and that it will do us an immense amount of good. In my opinion a Co-operative Milk Factory would prove successful. (Cheers.)

The President: Mr. Cousins has given us an interesting account of what has been done in the matter of tick eradication in Jamaica and he goes further by holding out a future development as an outcome of tick destruction. There are probably some of the gentlemen present at the Conference who would like to ask Mr. Cousins some questions. For my own part I should say that similar work in the matter of tick eradication should be carried out in each one of the other West Indian Islands. Mr. Stuart will be able to tell us what is being done in Antigua and Mr. Nowell can tell us what is being done in Trinidad.

Mr. Nowell: There is one point I would like to ask Mr. Cousins about. I notice at the Hope Farm that Mr. Cousins and ourselves belong to rather a different denomination in regard to tick control. In Trinidad we advocate sprinkling, whereas I notice that Mr. Cousins believes in almost total immersion (laughter). I would like to ask Mr. Cousins what are the pros and cons on that point.

Mr. Cousins: I would like to say at once that the gospel of sprinkling is an absolute heresy. You cannot kill more than 90% of the ticks by sprinkling. I am in the matter of dipping a thorough baptist and I believe in absolute immersion. It is absolutely necessary in tick destruction that there should be such an entry into the dipping tank that the animal enters abruptly into the baptismal tank and gets a complete immersion. You then get a 100% destruction of the ticks, and the only way is to immerse the cattle in a suitable liquid.

Mr. Moody Stuart said: For many years it was found hopeless to raise cattle owing to the ticks. Fortunately, we erected a sprinkling apparatus. That was about 10 years ago and now Antigua is quite a health resort for cattle. We began our method by giving sprinkling every week or 10 days to our own cattle and taking in others in the district at a very small charge, and the result has been certainly most satisfactory. You could not see a better looking cattle anywhere else than we have in Antigua.

Mr. Bovell: I should like on behalf of those who visited Hope Farm this morning and saw the administration to thank Mr. Cousins for all he did for us this morning. Mr. Cousins certainly has a most wonderful memory in regard to his cattle. He seems to know every little spot that is to be known about them and I ask him on behalf of the delegates to accept our most grateful thanks for all that he showed us and told us this morning.

Mr. Nowell: I would like to second that motion of Mr. Bovell's because I feel that this morning's visit to the Hope Farm will well repay our Governments for the expense and trouble that they have gone to to send us to Jamaica to attend this Conference. (Hear, hear.) I have no doubt I shall be able to convince them on my return to Trinidad as to the value of the Conference and that the benefits the delegates have obtained from it. Mr. Cousins referred to Trinidad

this morning as being a place where the Government Farm was supported by a Government grant and he seemed to speak rather enviously about that. Mr. Cousins also spoke of the benefits which Trinidad obtains from that farm. These appear to be benefits but they are the outcome of experiments in Agriculture in the West Indies. I have observed that wh rever you go in the West Indies the idea is to improve our agriculture and I believe that if in Trinidad we were better off for grass and pasturage, we might have had a better Government Farm than we have at the present time and I hope that in the future we will have a more improved farm in Trinidad.

Mr. Cousins: I beg to thank the gentlemen who have spoken on behalf of the delegates for their remarks in regard to what is being done at Hope. I must say that these remarks are most encouraging to us and all that the delegates have seen at Hope has been done by my staff. Mr. Martinez, the Farm Superintendent, has been most energetic, and he has put forward everything that has been done.

At this stage the Conference adjourned for lunch.

The Conference resumed at 2.20 p m. at the rooms of the Jamaica Institute.

Sir Francis Watts: I must apologise for being somewhat late. We will now ake up the coconut work which is on our programme. I will ask Professor Ashby if he will read his paper on Red Ring Disease of Coconuts.

Professor S. F. Ashby: I have some photographs illustrating the disease here, and I will be glad if they can be passed around.

(The photographs were passed round).

I must preface my remarks before I enter upon the subject of the disease with the statement that at the time I prepared this paper I was not aware that Mr. Nowell would be coming to Jamaica. As a matter of fact, it was intended that the Director of Agriculture at Trinidad should come, but at the last moment it was not possible for him to come, and Mr. Nowell took his place. I must state that Mr. Nowell was the pioneer investigator of the disease. He hit the nail on the head, and found out the particular cause of the disease that had been worrying the Mycologist of Trinidad for a long time. (applause). I would have deferred to him, and allowed him to have first say on the subject, but he desired me to go ahead, so I will do so.

"RED RING DISEASE OF THE COCONUT."

BY

S. F. Ashby, B.Sc.

This is a fatal parasitic infectious disease recently recognised as of wide distribution in the West Indian Region but known for nearly 20 years under the name of root disease in Trinidad and Tobago. It is present in Honduras, British Honduras, Panama, Venezuela, British Guiana, Trinidad and Tobago, Grenada and St. Vincent but has not yet been definitely reported from the Greater Antilles. The evidence suggests spread by means of seed nuts so that it may have been introduced already from Central America into one or more of the Greater

Antilles. Coconut planters in Jamaica should therefore be acquainted with the symptoms and the nature of the parasite.

It is characteristic of the disease that trees approaching bearing age or recently come into bearing are most subject under plantation conditions and that after causing losses for a few years the attack may wear off. It is therefore usually in the 4th or 5th year that the early cases may be looked for and after increasing in number for two or three more years, there may be a gradual or rapid falling off of fresh cases by the 9th or 10th year. Before the disease abates the loss of trees may amount to or exceed 30 per cent. in Trinidad or Tobago.

Symptoms of the Disease as described by Nowell and seen by the Writer in Grenada and Trinidad.

External Symptoms.—The first indications in trees already in bearing are the shedding of green nuts in all stages of development and withering of opened or unopened inflorescences. There follows a progressive yellowing and browning of the leaves from below upwards beginning at the tips, involving finally leaves not yet fully expanded. The oldest leaves may however not be the first affected. The leaves eventually give way and hang down or break 1–2 feet above the base. If the tree is allowed to stand the heart leaves wither and the central column falls over.

These symptoms resemble closely those associated with the form of budrot attributed to bacteria and as a fact in both Red Ring and Budrot the final condition is a soft stinking rot of the bud.

Internal Symptoms.—These are quite characteristic and distinguish the disease at once from any form of budrot infection or otherwise. In the stem there is a continuous dull red ring, 1–1½ inches wide, and 1–2 inches from the surface extending upwards from the base to a height of 4 feet or more, and then breaking into red streaks and scattered red dots up into the tender tissue below the growing point. In rare cases where the young leaves are the first to fall, the red zone may be central in the stem.

The leaves when split lengthways through the middle of the stalks show a dull red or sulphur yellow streaking and mottling from the base for 6 inches to 2½ feet, and this may be present even in young leaves which are still fully green.

The internal streaking and mottling in the leafstalks is often succeeded and marked by a diffuse wet brown rot of secondary origin, due usually to the common saprophyte *Diplodia theobromæ*. It is doubtless the cause of the leaves hanging down or breaking across in the stalks.

The Roots may be affected to a very variable degree. When diseased the normally moist white spongy tissue between the hard rind and the central strand becomes dry and flaky, and discoloured yellow to reddish brown.

Cause of Red Ring.

If a fresh scrap of the affected tissue from stem, leaf, stalk or root is teased up in a drop of water and magnified 20 to 50 times, eelworms, frequently in active motion, can be seen. Eggs, larvae of various sizes and fully grown male and female individuals can be found together especially in the stem and leafstalks, but less frequently in the roots. This eelworm or nematode, therefore, breeds freely in the ground tissues

of the tree, moving in the intercellular air spaces and puncturing the cells with a delicate spear protruded from the mouth which sucks up the escaping sap. The fully grown males and females are about ½mm. in length and only 1-140th mm. in breadth. The larvæ depending on age vary in breadth from ⅛ to ⅓ of a mm. The eggs straight or slightly sausage-shaped are about 1-24th of a mm. in length and 1 140th of a mm. broad. The worm therefore looks like a flexible needle when in motion.

Mr. Nowell, who was the first to observe the association of the nematode with the characteristic symptoms of the disease in 1917 in Grenada, found it present in all cases seen subsequently in Grenada, Trinidad and Tobago, and his findings have been confirmed by investigators in Central America. As the roots are not always affected and the red zone in the stem is a constant feature of pronounced attack he proposed to substitute "Red Ring" for the older less appropriate name "Root Disease," and his suggestion has been adopted generally.

Infection Experiments.

The first cases seen by Nowell in Grenada were on a Government plot of 68 trees planted in 1912 at Westerhall. Deaths from disease on this plot had begun about 1916 in trees planted 4 years before. In 1919, inoculation experiments were carried out on healthy looking trees (1) by inserting fragments of tissue taken from the red ring in a diseased tree into auger holes in the stems 1–2 feet above the ground, the holes being closed with tarred plugs of deal. After 60 days the three inoculated trees were felled and cut up, and were found fully infested with the nematode in stem, leafstalks and heart, with a pronounced red ring from the base to the bud. Adjacent trees remained healthy.

(2) By dropping fragments of diseased tissue 1-2 inches long and of similar origin into the crown without wounding. After 74 days the nuts on one tree had been shed and the leaves were yellowing and turning brown. All the leafstalks were infested by the worm and the red ring in the stem was pronounced from the base to a height of 8 feet.

Another tree which had only one fragment dropped among the young leaves was examined also after 74 days. Twelve leafstalks were found to be internally discoloured and infested by the worm.

You will note than when the inoculation was made near the base of the stem the worm worked up internally into the leafstalk and that when infected tissue was introduced into the crown, the worm entered the tree and worked down to the base of the stem; the trees were practically dead in 2–2½ months.

In 1921 I had some further inoculation experiments begun on the Westerhall Plot. Bags containing 5 pounds of salt were put above the heart of 8 trees now 9 years old and infested fragments of tissue were dropped into the crowns after 2 weeks. Two and a half months later all the trees were showing marked external symptoms of disease and were cut down and examined.

Two showed full infestation in leafstalks, stem and roots. Four were infested in the leafstalks and upper parts of the stems, which were internally of normal colour and free from the worm to a height of 2, 6, 7 and 8 feet from the ground, respectively. All four, however, were infested in the roots. In the remaining two trees the red ring was very faint in the stems 9 and 18 inches above the ground and no diseased roots were found. In half the trees there had been an infection at both ends—crown and roots, but the worm had not entered the stems

from the roots. In two trees no independent infection of the roots had occurred and as the worm and red ring had not quite reached the base of the stems the roots were still sound. The salt drip had evidently neither prevented nor delayed infection in the crowns.

In another experiment begun at the same time infected pieces of stem tissue from a diseased tree were buried in the soil to a depth of 2 inches in a circle 18 inches from the stems of 16 healthy-looking trees. Salt was mixed with the soil round 8 of these trees. After 5 months ten of the trees showed suspicious external symptoms and these were cut down and examined during the succeeding six weeks. All were found fully infested by the worm in roots, stems, and leafstalks and all showed a well developed red ring. Of the remaining six trees five were infested in the roots but borings at a height of 6 feet gave negative results. Two of these trees died from the disease about 6 months later; the other four are still alive. The most obvious inference is that the ten trees became infected in the roots by the nematodes escaping from the buried fragments of infected tissue and that the worms entered and worked up the stems from the infected roots. This conclusion was not quite established as the trees were not fully infected when cut down, moreover, a severe storm two months after the experiment was begun, injured the tops and rendered them attractive to palm weevils which in Central America have been observed to carry living worms on their snouts. I have been told by a mycologist who has studied Red Ring in Central America that he had cut down apparently healthy trees in badly infected plantations and found the red ring only in the basal part of the stem evidently due to infection through the roots. Salting the soil proved ineffective. At Westerhall 3 trees planted 2 years, and one planted 11 months were inoculated by dropping infected stem fragments among the leaves. After 2 2½ months all showed marked external signs of disease and were found to be fully infested. During the last two years several more 2-year-old supplies on the plot have died from Red Ring. Although as a rule the earliest cases on plantations do not show under four years, it is evident that younger trees can be infected and killed. In co-operation with Mr. R. O. Williams, at that time Agricultural Superintendent in Grenada, I inoculated full-sized green nuts by inserting an infected fragment into each husk. After 26 days the nuts were examined and found to show a distinct red ring halfway between rind and shell and a darker zone in contact with the shell. The nematodes were abundantly present in both zones. Although the worm has not been found in the husks of coconuts on diseased trees the result of this experiment indicates that nuts which have dropped may be infested from the soil through wounds in the husks, and the worm may multiply in the husks provided the tissue is still sappy. The larvæ are very sensitive to desiccation when dried naked on glass and exposed to the air, losing their vitality in a day. It is probable that like a number of pathogenic bacteria and fungi they, especially the eggs, may withstand desiccation for a relatively long period when dried gradually in a vegetable tissue like coconut husk. In Trinidad Red Ring has appeared on young cultivations on land cleared from forest and far removed from infested plantations; these outbreaks seem to point to infection carried the husks of seednuts. The disease has been present in Tobago for many years and was probably introduced into Grenada and St. Vincent in seed-nuts from that island. The disease is apparently endemic in parts of Central America and seednuts from there, unless from plantations definitely known to be free from Red Ring, should be regarded with strong suspicion. Two

seedlings taken from the nursery at the Botanic Station in Grenada were inoculated in the husks and replanted in pots. After three months several roots on each were infested and the worm was breeding in them, but the plants were quite sound in the stem and leaves. Some experiments are now in progress at Westerhall to determine whether seedlings inoculated in the husks when planted out become infected in the roots and how long this infection can continue before trees become perceptibly diseased. It is possible that the nematode may maintain itself in some of the roots of seedlings for several years before infesting the stems and leafstalks and killing the trees.

There is evidence at Westerhall and elsewhere that the disease can spread from tree to tree, but the problem of just how this occurs and the place on the tree where entrance is most liable to be effected have not yet been solved. It is safe to assume that the great breeding ground of the worm is in the ground tissues of the living tree especially the stem and that it is of great importance that the early cases be promptly detected and thoroughly dealt with. These may be quite few in number in a plantation so that vigorous action may be effective in stamping out the disease before it makes headway. The external symptoms in the leaves will arouse suspicion and a boring or some chops with a cutlass into the stem to a depth of about 3 inches 2 or 3 feet above the ground level will confirm it. As a rule, the tree will be fully infested and should be completely destroyed by fire. A method which has worked well at Westerhall is to dig up the tree, chop up the stem and leaves into short sections, and pile them into the hole, start a fire with the dry trash and cover with earth so that the material will burn slowly for several days, as in the method of burning charcoal.

Nowell has observed that in some plantations which are trenched between the rows the disease has been found to follow along the row without crossing the trenches. This suggests that the spread of infection in the rows might be sufficiently controlled by isolating the infected spot with cross trenches after burning the diseased tree and as an additional precaution isolating the adjacent trees on each side by further cross trenches.

In conclusion, I may say that a well illustrated account of Red Ring can be found in Nowell's recently published book "Diseases of Crop Plants in the Lesser Antilles," which should be in the hands of every progressive planter in the West Indies.

Red Ring Literature.

Nowell, W.
West Indian Bulletin Vol. 17, p.p. 189—210
do do Vol. 18 " 73— 76
Agricultural News Vol. 17 " 398
do do " 18 " 398
do do " 19 " 222
Ashby, S. F.
Agricultural News Vol. 20 p.p. 334 & 350
do do " 21 " March 18.
Cobb, N. A.
West Indian Bulletin Vol. 17 p.p. 210
Nowell, W.
Diseases of Crop Plants in the Lesser Antilles.—London 1923

I may s y this is a book by Mr. Nowell on this disease, which deals with the subject very completely and comprehensively. It is also profusely illustrated and should be in the hands of every practical planter and agricultural officer. I is sold at 12 6, and at the price, is one of the cheapest books on the market, and should be in the hands of a very large number of people interested in coconut planting (applause).

Sir Francis Watts: Mr. Nowell, will you supplement Mr. Ashby's remarks.

Mr. Nowell: Mr. President, ladies and gentlemen, I have very little indeed to add to the admirable account of Red Ring disease given to us by Professor Ashby. There are certain points of detail on which one might discourse, but such discourse would be hardly interesting to the general Conference. But I think perhaps it is necessary that I should make one or two general remarks regarding the incidence of the disease, so that if you see it in Jamaica as you probably will sooner or later, you will know how much or how little you will have to fear. Our experience in Trinidad of this disease is now rather lengthy and fairly advanced. It is a disease of adolescence in coconuts. I have met planters whose estates were aged 7 or 8 years, and where they had this disease, and they told me they would be very glad to sell the whole of their trees at 1/ a piece and get out of it; I met these same planters a couple of years later, and they put the price of their trees at $5 each, the reason being that at the time they looked like losing the whole of their cultivation we found the cause of the trouble. The difficulty, and it is a real one, is that there is very little exterior evidence of the cause of the infection in its early stages. In the meantime you may have lost 30 per cent of your coconuts, and you d > not know how many of the seedlings you put in are going to succumb in their turn. We have not got sufficient data in Trinidad to make any definite pronouncement on the subject. The point I want to emphasise is that not only is there no cure for it, but I have no hope that any cure will ever be found. I know it is said that experiments have been made of injecting Thymol into trees, like hey do for hookworm, and it is claimed, with good results. But I do not think the use of Thymol as a cure will be practical for the reason that you do not know a tree is sick until it dies, or it is at a stage just previous to death. External signs do not appear until the tree is doomed, or already dead, then the red ring is found in all such trees. When the first case is found, it is my experience that it is very far gone indeed. You plant your field, and four or five years later you find just one plant here and there, perhaps widely scattered, showing symptoms of this disease. The evidence all goes to show that these are cases which arose from the original case, but not from a progressive development o' th original infection. What I mean is, you get these spasmodic cases continuing the infection. Then you go further, you get one plot infected, and then another, and then you have this 30 per cent. loss, which is very largely a matter of second infection from the few cases that first arose. It is obvious if you are going to meet with this loss, that it will certainly pay to dig up all the trees in the infected area, and make a charcoal pit of them, rather than being merely content at chopping down the infected trees, and saying you can do nothing more. It is the height of economy to spend any money necessary to deal with the first cases, and get them very thoroughly destroyed, because you are combating not only that original infection, but all cases that would eventually arise from it. The only safe cri-

terion for diagnosing red ring disease, is the presence of the red ring. There are other appearances, which while quite characteristic, are also shared by other coconut diseases. In Trinidad, I myself would never dare to diagnose a case as being Red Ring unless I had actual facts, and the characteristic effects produced by the disease. Once this is seen, you cannot fail to know the disease. Professor Ashby has mentioned the matter of infection, and its introduction. This is very difficult to trace. It is no easy matter to find, owing to its surroundings, an animal that measures a millimetre in length and very much less in width. It is very difficult to determine and state positively, how infection was introduced in Trinidad, but the general evidence points to outside causes—that the infection was imported. The remedy for this would be to prohibit importation. There is another alternative known as disinfection, but I think it may be stated with a considerable amount of truth that while we all recognise the measure of protection we get from spraying, it has to be thoroughly done before they would probably be quite safe as regards infection. So that if it were desirous to introduce in Jamaica from outside sources a very desirable kind of coconut, you have to be quite certain the spraying is done by a responsible person. Of course, if when the coconut were taken from the tree they did not rest on the ground, that would probably be an effective method, but at the same time the risk of getting in a trouble you have not already got in is so great that in my opinion such introduction should only be made under the care of the Department of Agriculture, and under very careful conditions even then. Red Ring disease as I have pointed out, is one of the most serious diseases that the coconut planter has to face; most of the great loss of money it has caused to the estates of Trinidad and other places is due to the neglect of fairly simple and obvious precautions that could have been taken. I do not think the disease is one which compares with other troubles, which face the coconut planter, such as the Bud Rot, which really are very serious for the simple reason that we have not yet found out how they are caused, and therefore cannot take any rational precautions for their prevention. Another method of precaution was alluded to by Mr. Ashby, and I think it is quite sound—the method of trenching. I have noticed in Tobago, where the trees are down with Red Ring, that the diseases always progress in straight lines. On the last occasion when I was in Tobago a few months ago. I notice there were 18 trees that had it in a row, but there was no evidence of the disease on either side of the trench. It does appear, that trenching, particularly in a serious patch, at any rate, is an effective method of checking the disease. The place at which infection takes effect. I find it rather difficult to accept what Professor Ashby has said with regard to root infection. I have carried out a large number of injections in the tops, with the result that the infected plants had died immediately. It was just the reverse with infections in roots. While I have never failed to get infection through the roots, the experiments I have carried out on a good many trees, getting infection through the roots, have failed to produce the death of the tree. The roots were infected, but the infection had not progressed in the tree to the top. Another point that makes me doubtful about root infection, is that trees escape infection once they get beyond a certain height. If infection took place by roots I see no reason why a tree 30 feet high should be any more immune than one 5 feet high. My experience is that the taller the tree the less chance of infection, while if it was communicated through the roots height would make no difference. There are, however, several

points in the matter which need to be cleared up, and I hope you will not be scared about this disease, but will be able to give it a rational reception should it ever arrive in Jamaica (applause).

Mr. H. H. Cousins: I think it might comfort our friends in Jamaica to realize that the Government of the country have absolutely prohibited the introduction of coconuts into Jamaica, and it can only be done by the special intervention of His Excellency the Governor. And so long as I act as his adviser I will see that no coconuts shall be admitted here, however desirable they may appear to be. We prefer to stick to our own coconuts and do the best we can with them.

Sir Francis Watts: Does any one want to ask any further questions about this disease, which is gradually spreading in the West Indies? So far, it would seem that Jamaica is free from it, but it would be unwise after our experience with the bud rot disease that we should leave any precautions untaken. As both speakers have stated, it is one of the easiest diseases to diagnose and recognize. The strange thing is that for years it could defy investigations in Trinidad, while continuing to spread. No clear and correct diagnosis was made until Mr. Nowell found out what it was, and then it was wide-spread in the islands and also very widely in Central America. Immense areas in Central America are devastated by the disease which remained unknown until found out by Mr. Nowell, who has rendered a big service to science in this connection. He has told you that once a tree is atacked there is no cure for it. It is no good attempting to treat that tree—to save it. If a tree is found infected, at whatever stage the infection may be, it should be cut down and burnt at once. I should like Professor Nowell to tell us something more of the rate of infection, and virulence, and in addition, if he has found the disease in other things than coconut palms –if he has found the existence of the minute organisms in other things than the coconut palm. In view of what has been said about this disease of Red Ring, I would strongly advise all interested in coconuts to examine every suspicious case where the appearances are Bud Rot, and bore a hole with an augur to see whether it is not Red Ring. It is most easily diagnosed.

Mr. Nowell: I have not got the exact details in my possession, or any memory of the incidence of the disease in its relation to certain of the palms. I carried out experiments a few months ago at the experimental station at Trinidad with the Gru Gru Palm, and the Cabbage Palm. In the Cabbage Palm the results were so remarkable, that I do not believe them even yet, although I have the figures duly filed, and I made the experiments myself. We had young trees growing, forming an avenue at St. Clair Experimental Station, with no suspicion whatever of Red Ring. The height of some was 8 to 10 feet, at which size the Cabbage Palm tissue is very soft and spongy, and offers a very suitable medium for the development of disease. I introduced small sections of Red Ring into the trunks and in less than three weeks the zone of infection had spread from top to bottom, and some of the palms were absolutely moribund if not quite dead all the way. The ring had a diameter of 18 inches at the bottom and 6 inches at the top, and was 8 feet long; each fragment was so fully infected that when placed under a microscope it appeared as if you were looking at a basket of eels. Then the rate of growth was so phenomenal that I can hardly believe it yet. The Gru Gru Palm which is very much harder, gave no such striking results. The trees were 30 feet high, and it took 8 weeks before the infection reached from the base where the injections were made, to the top of the palm. But even that is extraordinary,

when you consider the hardness of the stem of that palm. One or two other palms I have tried have shown no evidence of infection. But I have proved that other palms besides the coconut can be infected, and it may be that this disease is a native of some other palm in Central America, and has been distributed on the seeds of the coconut, and has found in the coconut a suitable host.

Sir Francis Watts: We have on the agenda a general discussion on the coconut industry. Does any one wish to say anything on that head ? I don't know if any one wishes to speak on the subject generally or not.

Mr. Murray: I would like to ask a question with regard to Red Ring disease. I would like to ascertain if there is any discolouration of the stalk by which it can be ascertained, or if the disease is only to be found in the inside tissues.

Mr. Nowell: The answer is no. There are no external symptoms, nothing external by which the disease can be indicated. The heart leaves are generally so discoloured by other parasites, that this minute animal cannot be seen, and even this is no guide, for sometimes the leaves are not infected, while at the same time the inside of the trunk is fully infected.

Sir Francis Watts: Is there to be no other discussion in regard to other aspects of the coconuts ? We have only dealt with one aspect of the diseases of coconut. If there are no further observations then I will ask Professor Ashby to give us his observations on "Wither Tip of Limes."

Professor Ashby: Before I read my paper I have some specimens here of "Wither Tip of Limes" which I would like to pass round to the Conference, and another disease, which is a disease not to be confused with "Wither Tip of Limes," but occurs very frequently in sour oranges. This paper is not intended to be an elaborate account of the disease. It has been inspired by the fact that this disease, which has been with us in the West Indies for a number of years, has quite recently appeared in an important centre of limes and lime products. Therefore it is necessary that something should be said on it, and that this particular difficulty of Dominica should be referred to.

"WITHERTIP AND BLOSSOM BLIGHT OF LIMES."

BY

PROF. S. A. ASHBY, B.Sc.

This very serious disease has been present for many years in Florida, Cuba and probably Porto Rico and was recently reported from the Philippines. It became prominent in Trinidad about 1917 and soon after in British Guiana. It was not known in the other islands of the Lesser Antilles until detected in Dominica about April, 1922. In May, I found it on several of the higher lying plantations at the south-east but saw no evidence of it in other parts. By October it had been reported from practically every locality in the island, which is the main producer of lime products in the West Indies, and is dependent for its prosperity on the crop. A reduction of about 40 per cent. in the main crop of 1923 is attributed largely to the disease, although an abnormally dry period from October, 1922, to June, 1923, must have contributed.

The industry had been severely affected during recent years by the depressed state of the market, and, with the disease added, the situation has been critical for many estates, especially those situated in the higher and wetter districts, where the annual rainfall runs from well over 100 to over 300 inches. In the coastal districts where the main crop sets during the dry season from February to April, the effects of the disease may prove less serious, and, provided the market improves, the estates may pull through until control can be effected, which is not likely to be by any direct method such as spraying and dusting, but rather by replacing the susceptible variety with resistant kinds, a slow process demanding a number of years of patient propagation and testing out of varieties. In Trinidad the disease has since 1917 been the limiting factor in lime cultivation, but in 1923 many plantations yielded a heavy crop after three successive years of negligible production.

Symptoms.—The disease affects the young shoots, blossoms and young fruits. The tips of the young shoots are killed, following bad infection, and the leaves attacked at the margins and in scattered spots causing distortion. In severe attacks lesions develop on the shoots, and cut off and kill all growth beyond. This injury is most damaging to young trees, which are set back in growth. On bearing trees the most serious loss is occasioned by the destruction of the bloom and the setting and recently set fruit. Only young and tender tissue is infected, the fruit becoming resistant when about half an inch in width. The fruit may be infected at any point, but frequently through the style as it sets. The spots found on the older fruit dry up, leaving brown scabs and causing distortion: they are weak places in the rind and as the fruit develops splitting may occur. Fully grown fruit blemished and misshapen by these spots is unfit for the green lime trade with the United States, which at times is quite profitable and which has helped to offset the low market for juice and citrate.

Cause.—Withertip and Blossom Blight are due to the same fungus, a species of Glocosporium. It has been regarded in Florida as a strain of the widespread saprophyte, *Colletotrichum glocosporioides,* which is itself capable of causing a dieback of the twigs of debilitated trees of various species of Citrus. Clausen working in California with the fungus from limes in Cuba described it as a distinct species— *Gl. Limetticolum.* The Dominica lime fungus is identical with that in Trinidad but does not conform fully with Clausen's description which is probably too restricted. At any rate the lime fungus attacks only the tender tissues of the lime, and perhaps the lemon, and normally no other kinds of citrus. I found it causing a blossom blight of navel orange, in specimens from one estate in Dominica, isolated the fungus and produced a withertip in lime seedlings by spraying it on the flush, from which it was re-isolated. The blighted bloom was on a single orange tree in a heavily infected lime plantation so that the flowers were exposed to a persistent abnormal amount of infection. I failed to infect the flush of navel orange seedlings with the same culture.

Visible lesions appear rapidly (within a few days following infection) and the pink slimy spore masses are produced promptly in great abundance. The spores drying to a horny mass are not spread readily by wind but rather by driving rain, surface water, rain splash, insects, especially bees and leaf-eating kinds, and by means of smears in the clothing of man. If it be admitted that the disease in Dominica started in one locality, its spread within six months, throughout that mountainous island, with its large stretches of bushland, is difficult to explain unless it was carried on the clothing of man, or by birds of passage.

Control.—Trials in Florida have shown that the disease can be controlled fairly satisfactorily by thorough spraying of the trees at the right time with bordeaux oil emulsion, or less effectively with lime sulphur. A clean-up spray before the main crop flush followed by 2 or 3 sprayings at the height of the bloom and when the fruit is setting have been recommended, a treatment which has proved effective against citrus scab, which also attacks only young and tender organs. In Dominica, the low production, the present low value of the products, the difficult situation of the plantations, often on steep hillsides, and the inefficient labour make repeated sprayings impracticable; dusting experiments with mixtures of lime and dehydrated sulphate of copper are now under trial in some favourable situations. It would appear that the only effective way to meet the situation in Dominica is by replacement of the susceptible West Indian lime with highly resistant or immune kinds, a number of which obtained from the U.S. Department of Agriculture are now being raised at the Botanic Station.

Mr. Wiltshire: May I be permitted at this stage to ask Mr. Cousins a question? I would like to know whether Jamaica is free from this pest as you are from the Red Ring of coconuts.

Mr. Cousins: We have not seen it in Jamaica.

Mr. Wiltshire: The Imperial Department of Mycology is interested particularly in this question of the "Wither Tip of Limes," because it constitutes a very serious position in Dominica. In the first places I think it is of immense importance as showing the damage a fungus disease can do. Two years ago the Citrus industry of Dominica was in thriving condition with very little disease affecting it; here we are to-day with the very existence of the industry threatened. This is a very clear instance of the importance of mycological research. Whilst there has been some mycological research in the past, which did not seem to have been fruitful of result, if we had had more research work persistently carried on, we might to-day have been in a better position to advise the planters. Professor Ashby has said that in his opinion the only thing which promises any success in Dominica is the replacing of the West Indian limes by immune or resisting limes. That in the long run would, I believe be the solution of the problem, but up to the present I am not very well acquainted with the different species of limes. We have now one type of lime in cultivation in Dominica, and if we are going to bring in new types of limes it is going to be a long process involving a number of years. The question is whether the planters can wait for a new satisfactory type of limes to be developed. It is not only a question of annual loss which we are facing now. It is a question of what is going to be the future of the industry. Is it going to exist, or go out of existence altogether? Is the planter going to be encouraged to continue his cultivation, or is he going to be advised to scrap his cultivation altogether? This is the problem. It is an important matter, and is essentially a question of the day. We want to be able to tell the planter what to do. In this connection it is a very important fact to remember that in Florida, I think, they have actually controlled this disease by spraying. I know that conditions there are very much more favourable for control than in Dominica. I have not had the opportunity of going to Dominica yet, and therefore I cannot speak very authoritatively, but I think at any rate the fact that the disease is controlled in Florida, warrants a trial being made in Dominica. It is a matter of importance to the Dominicans themselves with their lack of intensive cultivation and very mountainous districts.

There are many factors to be considered against spraying as a control for this disease in Dominica. But I do think we want actual data as to the result of such spraying in Dominica, figures as to the cost; whether it is economically possible, whether it is effective. Whether the dusting which is effective in Florida will be effective in Dominica, it will be impossible to say until experiments are tried. In view of the serious conditions facing the industry, I think it is very desirable a means of control should be experimented with, with a view to finding something that will help the planters in their present crisis (applause).

Mr. De La Mothe: I would just like to read a few observations made by Mr. Walters of St. Lucia, who is connected with the Agricultural Department of that Island. I represent Grenada, and know little about limes personally. Mr. Walters' observations are:—"In connection with diseases of limes, Mr. Walters, the Agricultural Superintendent presents a short note drawing attention to the occurrence of 'die back' which he believes to be associated with bad soil conditions, especially where cultivation is neglected. He states that recovery has been brought about by increased deep digging and applications of large amount of vegetable matter to the soil. He advocates the spraying with a fungicide and the pruning of dead branches.

He draws attention to the wilting point of the lime tree, and states that wilting was observed to take place when the air temperature was 88 degrees F. the surface soil then being dust dry and the sub-soil slightly moist.

He points out that *Casuarina* trees growing near to lime trees exercise a prejudicial effect on the latter, owing probably to the drying effect on the soil; in consequence it appears undesirable to use *Casuarina* trees for wind breaks in lime plantations.

The Agricultural Superintendent draws attention to the high charge incurred in shipping certain kinds of produce from St. Lucia and argues that these charges act very detrimentally particularly where efforts are made to introduce new products. He gives detailed examples of the charges incurred in respect to sugar, coconuts, and lime oil. Those are the observations of Mr. Walters of St. Lucia. I don't know that they throw very much light on the subject, but I give them for what they are worth (*Note.—Mr. Walters' paper is given in full in Appendix "A." Ed.*)

Sir Francis Watts: Does anyone wish to make any further observation on this matter? If not, there is one question which I have been asked to bring before the Conference. There are two gentlemen present whom I am asking to make brief statements concerning the raising of goats. A good deal of excellent work has been done with goats in recent years in Barbados, and the enthusiasm for goats is extending to Trinidad. Perhaps Mr. Bovell of Barbados will tell us something about the goat industry of Barbados, and we can also hear something from Mr. Barnardo of Trinidad.

Mr. Bovell: With regard to Barbados, we have stopped importing goats into Barbados, and the strain of these goats has extended all over the island. The Department of Agriculture got out the goats, and gave them to the planters to keep for use of the peasants, so that we now have the strain of the goats all over the island. I have heard of one of these goats giving a yield of 16⅔ pints in 24 hours.

Sir Francis Watts: The Barbados pint is 16 fluid ozs., not 20.

Mr. Bovell: But even at that it is a considerable yield for a goat.

Sir Francis Watts: Will you mention the type you have got?

Mr. Bovell: We have only the Saanen. Unfortunately at the present time owing to foot and mouth disease in Europe we cannot get any more Saanens. Some few years ago some rich people in America wanted to get in that type of goats from Europe, and to get over the difficulties in their own country, they want d to convert Barbados into a quarantine station for the United States. They wanted to bring out 500 goats from Europe, keep them at Barbados for the quarantine period and then send them on to the States. We thought this rather unfair to Barbados, to subject her to such risk, and we would not allow it—we would not run the risk of seeing Barbados stock falling before foot and mou'h disease.

"THE GOAT IN TRINIDAD."

BY

W. S. E. Barnardo, M.A.

The first thing in talking about goats, is to try and disabuse you mind of the peculiar idea that all goats smell, and that all goats' milk tastes of the smell. The dairy goat neither smells, not does its milk smell, nor has it the characteristic goat taste. That is the first thing to remember. As Mr. Bovell has said, Barbados was practically the pioneer, the introducer of the dairy goat, so far as the West Indies are concerned. They were not only very successful, not only in importing good goats, but in breeding them. They preferred to breed the Saanen and Toggenburg, and were very successful in breeding up the common goat from being a miserable beast without use in life, who lived on any old thing, and used to produce anything from a cup to a pint, until you got an animal which, as Mr. Bovell has said, gives a very large quantity of milk. You must not look upon the goat as a useless animal, through its smell. It has been estimated that a goat, a good goat, is better than a cow; that size for size, it gives more milk than a cow. I go further, and say the average dairy goat will give in one lactative period a bigger bulk of milk than ordinary good dairy cow. You will seldom get a cow, which after a lactative period extending for 16 months, will give beautiful milk. On the other hand, I owned one goat which up to 16 months after she had kidded was giving four bottles of milk per day. You will not get very many cows doing-that. We have gone in for goats in Trinidad to such an extent, that we have to a certain extent denuded Barbados of her good goats, and now they are coming to us for goats. (*Mr. Bovell*: Are you stilll getting many, sir?) No sir, but we used to get a good many goats from Barbados, of a good strain, and we have been successful with them. And as I have said, we have had enquiries from Barbados for goats. We have a goat club in Trinidad. The Governor is President, and we have an energetic secretary. I know people are inclined to laugh when goats are mentioned, but this is a serious matter. We should laugh at people who do not keep goats. I would not keep a cow in a yard; having kept a goat, I would not go back to keeping a cow. As a dairy animal, kept in an ordinary West Indian town, it is extremely hard to keep a cow perfectly clean. A goat is a small animal, and from my experience is much easier kept clean than a cow. There are certain things you must observe with a goat. To keep a goat sanitary, and to get the best results, you must keep her clipped. You should clip her about four times a year. After grooming once a week,

and clipping her, you must provide her with shelter against weather. You must remember that highly bred goats cannot stand in the rain and sun to the extent that the cow can. The goat is a very wise animal and if you provide the shelter, she will not wait until the rain comes for you to put her into it. The moment she sees a cloud she goes into it. The goat has many advantages. In a place like Trinidad, where our rainfall is greater than here, and where you have a clay soil, you have to pay a little attention to their hoofs. But that is very easy. It is only a question of trimming them with a penknife now and then. We know that the goat is subject to strongylosis, but when you see the first sign in the animal, give 20 grains of copper sulphate, if an old goat, and in young goats 10 grains, gradually increasing it as it gets older. There is the question about its keeping. The young of the goat is very easily brought up. They have been brought up so long under strict dairy conditions—I speak of the more or less pure bred goat—that to a larger extent they have lost the desire to suckle their young at all. In a great many cases they will not allow the young to suckle. Experience has shown that the kid almost as soon as it is born—as little as within an hour of its birth, will put its head down to the milk bowl, and one does not have to use the finger. That means a big saving of trouble in looking after the goat. In Trinidad we have the bad habit of allowing the mother to suckle the kid. With regard to the question of goats' milk, goats milk I am told by people, is much easier to digest and much better for children and invalids, than cows' milk. First of all, I believe I am right in saying that the fat globules in goats' milk are much smaller and more easily digested than similar globules in cows' milk. Then the goat has rarely been known to have tuberculosis, and there is no case on record where a goat with tuberculosis can transmit to humans. With the cow it is another thing. Consequently, you do not have to boil your milk as in the case of cows' milk. Then the goat is very easily milked, and the milk will keep without being boiled, for 36 hours. In Trinidad you cannot keep cows' milk even for a day, without boiling it. That is a big point, particularly when it applies to children. I have known of cases where the children of poor parents, and people who have money and can afford it, who have tried every single infant food on the market. They tried cows' milk and sterilized cows' milk, and all the patent foods on the market, and nothing could stop the intestinal troubles. But when they tried goats' milk the trouble ceased, and immediately the children began to thrive. This is a very strong point, and one that should appeal to the small settlers. Anything that tends to give a better milk supply in countries like Trinidad and Jamaica is something to be helped on in every possible way. While I do not want in any way to stop the production of condensed milk, or throw cold water on the scheme Mr. Cousins is so ably putting through, I think it will not be denied that fresh milk is better than condensed milk, and that goats' milk is preferable to cows' milk. The cost of the upkeep of a goat is small indeed. It is very hard to say what it will cost here, because I do not know your food supplies. In Trinidad I think the correct cost, to keep these goats works out at $3 per month, including proportionate wages of a boy to look after them, the cost of concentrated food and the cost of green fodder. In some places a large herd would cost more, but in Trinidad it costs one very much more to keep a cow—very much more. Goats can get on with much less than a cow wants; you don't want for a goat luxurious grasses such as Mr. Cousins was displaying to us at Hope. You need that for a cow, but a goat will take any old thing from a

"piece of string to a packing case." You have potato tops, which is an ideal food for goats, and apart from concentrated foods, if you look at the goat as a milk producing machine, what it eats is returned to you in the form of milk. Mr. Bovell has told you about the quarantine for foot and mouth disease, and how Barbados had refused to be a quarantine station for the United States to get goats from Europe. We in Trinidad decided to take up the goat industry. We imported 10 goats—8 does and two bucks, through the Department of Agriculture, and one of the bucks of the original number was obtained for the goat club; and he is now standing for service at the Government farm. These were pure bred Saanen and Toggenburgs. Outside of that we have had shipments of Cahmorie which is a Swiss breed; a horned breed. I would not recommend them, because horned goats are a nuisance. I may point out that in Switzerland they destroy any young with horns; and I would never advise anybody to keep a goat with horns. Mr. Bovell has told us something about the yield of milk. It is very interesting to learn that in Barbados, which is a very dry place, with a very dry climate, the goats give such quantities of milk. I would like to tell you what we get in Trinidad. We reckon in bottles, six bottles to the gallon. We have a goat there, a Saanen, which gives 14 bottles daily, which is roughly over two gallons per day. I don't say every goat does that, but we have one goat doing it. It is in Port-of-Spain, in a little back yard, not 15 feet square, with a shelter for the goat when it rains. That goat lives on brick bats, a certain amount of concentrated food, and the potato heads that it gets from the garden (applause).

Mr. Cousins: If there has been any benefit from this Conference in Jamaica, I feel sure this intrusion of goats into our proceedings will be most beneficial. I shall now try it as a venture again. I may say that from what I had learnt from experience, I have been a little shy on the goat in Jamaica. I first investigated whether we could get tropical goats, having the idea in my mind that the tropical goat would be the most suitable for Jamaica. There is a magnificent African bred Nubian goat, but we found on investigation that the Nubian goat, or the Anglo–Nubian, would not serve our purposes. We were advised that in Egypt there were no goats worthy of our attention. Then we were advised to get goats from Malta, as being the best goats for Jamaica. But there was the great danger of introducing Malta fever here, and we know the terrible thing it was among the men of the Royal Navy when stationed there. We were quite right in refraining from bringing those goats here. Since we have heard of the wonderful results that have followed the introduction into Trinidad of goats from Switzerland, we will have a little more confidence, and we will try to get a few of those goats here and see the results (applause).

Mr. Murray: I would ask Mr. Barnardo if he would kindly say something more to us about the goat club in Trinidad. The Agricultural instructors here are particularly interested in that feature of the question. They would like to hear something more about the club; how it is formed, and how it is run.

Mr. Barnardo: The Goat Club in Trinidad practically owes its inception and its life to our enthusiastic Veterinary Surgeon, Dr. Shannon, who originally came from Barbados. He is now attached to the Government farm, and I am sure he would be only too willing to send you all the information he possibly can with respect to the Goat Club. Briefly, the Club consists of members who are interested in the question of the goat, and try to grade it up by the infusion of imported

stock with the ordinary country goat. It is extraordinary how you can grade up the ordinary goat by the use of imported stock. We have a stud book, so that the goats can be registered, and generally try to promote the interests of the goat, especially amongst the small settlers. We have a society in Trinidad, the Infant Welfare Society—I don't know if you have it here—which does all it possibly can to prevent the use of an impure supply of milk. Several of the prominent members of the goat club are people who take interest in infants' welfare. The grading our goats up to something that is worthy to be called a dairy animal, has had a marked influence for good on the welfare of the children of the colony (hear, hear) especially of the working classes. I am certain if you write to Dr. Shannon he would be only too willing to send you all the information he can. I may say that the Agricultural Society looks upon our club as doing such useful work that they have affiliated us (applause). I may mention that we had a show just before last Christmas, and considering that it was our first show, that notice was only given three weeks before, and we did no particular work on it, because Dr. Shannon was very busy with other matters, we thought we did well. There were over 60 goats of high milking capacity, and of good milking strain shown at that exhibition.

Captain Hill: It might be rather improper on my part to interfere in a discussion about goats, because I am a botanist, and that is just the reason why I do so. I want to say this: Breed all the goats you like, and keep all the goats you can, but gentlemen, keep them under control. For heaven's sake, don't let them go wandering about the world. The destruction that they cause from the botanist's point of view is most deplorable. Cyprus which had a wonderful flora, has been perfectly denuded of vegetation by goats, and the same thing happened at St. Helena, whose rich and interesting plant life has gone through the goats. And one can read the same story all over the world. Keep your goats, and get your milk, but keep them under control.

Sir Francis Watts: We will meet in this room at 9 o'clock tomorrow morning, when we will take up educational subjects. Sir Arthur Shipley will speak on the subject of the Imperial College of Tropical Agriculture.

The Conference adjourned.

FIFTH DAY.

The Conference resumed its sitting at the Jamaica Institute at 9 o'clock on the morning of Friday, February 1st, 1924, under the presidency of Sir Francis Watts, K.C.M.G.

The President said that they would take the Educational subjects that morning. In the afternoon it was hoped that His Excellency the Governor would be there. He (the President) proposed to give a short account of what had been done to attain the establishment of the Imperial College of Agriculture, and Sir Arthur Shipley would speak on what had been done, the future work of the College and the support which was necessary.

"THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE."

BY

Sir F. Watts, Principal.

The question of establishing an Agricultural College in the West Indies has been discussed for something like half a century or possibly even longer: time does not permit of a review of the many proposals that have been put forward. The subject was actively discussed in 1910 and 1911 in a discussion at a meeting of the Royal Colonial Institute, on November 29, 1910, when Professor Wyndham Dunstan, Director of the Imperial Institute strongly advocated the formation of an Agricultural College within the Tropics; these views he amplified in an introduction contributed to Mr. H. Hamel Smith's "Soil and Plant Sanitation on Cacao and Rubber Estates" and in a letter to the Times dated April 29, 1911. In these discussions the suitability of Ceylon, of the Federated Malay States and of the West Indies as sites for such a College were referred to, and the advantages offered by each contrasted. The subject was considered at several of the West Indian Agricultural Conferences and many schemes have been put forward, but until 1919 nothing tangible resulted.

In that year, as the outcome of representations made to him, Lord Milner, K.G., G.C.B., G.C.M.G., then Secretary of State for the Colonies, appointed a Committee to consider whether it was advisible to found an Agricultural College in the West Indies and, if that was thought to be the case, to make recommendations concerning the situation, constitution, management, finance, scope and other matters relating to the foundation and operation of the proposed College.

The Committee presented its report on August 22, 1919. The proposal to found such a College was unanimously supported and recommendations were made as to its situation, incorporation, constitution, finance and other matters. This report is reproduced in the West Indian Bulletin, Vol. XVIII., p.p. 1-12, and is thus available for future reference.

After considering the report Lord Milner submitted it for the consideration of the Governments of the several West Indian Colonies, inviting their support in the event of the proposals having their concurrence; the replies received were such as warranted the taking of steps to incorporate the College and make the necessary arrangements for its constitution and working. Accordingly, Lord Milner invited the Committee to continue its functions and to advise as to the steps to be taken to attain these ends; as an outcome of the Committee's recommendations the College was duly incorporated and registered on September 2, 1921, under the Companies Acts, 1908-1917, as an Association Limited by Guarantee. Immediately after this the control of the affairs of the College was entrusted to the Governors appointed under the terms of the Articles of Association.

The Governors of the College form a body known officially as the Governing Body composed as follows:

(a) Ex-Officio Members:—There shall be two ex-officio members, namely:—

(i) The Senior Financial Officer for the time being of the colony in which the College is situated, and

(ii) The Principal of the College for the time being.

(b) Nominated Members:—There shall not be less than 8 nominated members who shall include:

(i) A group of members not exceeding three in number nominated by the Secretary of State for the Colonies.

(ii) One member nominated by the Academic Board of the College.

(iii) A group of members not exceeding ten in number nominated by the contributing Colonies.

(iv) A group of members not exceeding six in number nominated by the Contributing Industries.

(v) A group of members not exceeding six in number nominated by and representing such Academic Institutions in the United Kingdom as may be invited to nominate each one member.

Briefly stated the College is at present supported in its financial aspect by the contribution of annual sums from the Colonies of Trinidad, Barbados and the Windward and Leeward Islands equivalent to one half of one per cent. of their revenue, the Imperial Government has agreed to contribute £15,000 spread over the period of 1922-3 to 1926-7 and the Government of Bermuda is contributing £100 a year. In addition to this, contributions to the maintenance have been made by Mr. J. W. Stephens of Trinidad, Messrs. Cadbury and Fry, the British Cotton Growing Corporation, while the machinery for the equipment of the Model Sugar Factory, to which further reference will be made later, has been generously contributed by various British Sugar Machinery Manufacturing Firms. This machinery is estimated to have a value of over £20,000 and constitutes an important addition to the College equipment.

Provision was made for starting the building and equipment of the College by the contribution of £50,000 by the agricultural and commercial interests of Trinidad; the planters and merchants approached the Government with the suggestion, which was at once adopted, that export duties should be placed on the principal products of the Colony with a view to raising £50,000 in the course of two years. Owing to the depression in agricultural affairs the period during which this amount is raised was somewhat extended, but the generous proposals of the agricultural and commercial community have been carried out.

In addition, the Government of Trinidad has generously granted a magnificent site of some eighty-four acres for the use of the College; this is situated at St. Augustine, 7 miles from the boundary of Port-of-Spain, in one of the most easily accessible districts of the colony, combining agricultural and residential facilities in an unrivalled degree.

The land was taken over in March, 1922, and the work of clearing and renovating an old hospital situated on the site and purchased from the Government, was begun towards the end of that month; the work was energetically pushed forward, and the College was formally opened for teaching on October 16, 1922, by His Excellency Sir Samuel Wilson, K.B.E., C.B., D.S.O., the Governor of the Colony. Good laboratory and class room accommodation was thus provided, which has subsequently been considerably augmented by the enclosure of the space beneath the original building. This first building now contains the offices of the Principal and Secretariat, 11 good and well fitted laboratories and class rooms provided with a good water supply, adequate drainage, gas and electric service, the two latter being operated by plants belonging to the College. In it are also the offices of the Technical Assistant and a number of store rooms. In the grounds attached to this building are two common rooms for students, lavatories and other buildings, carpenters' shop and stores.

The Academic staff now comprises besides the Principal, Professors of Agriculture, Botany, Zoology, Chemistry, Mycology and Bacteriology, Economics and Sugar Technology, with Demonstrators in Zoology, Botany and Chemistry.

There is also a clerical staff and a Technical Assistant who has charge of lands, buildings and equipment.

The College offers a three years' course leading to a Diploma, particulars of which are given in the Prospectus, it also makes provision for post-graduate study, and for special studies and investigations on the part of students desiring to extend their knowledge of subjects pertaining to tropical agriculture or to undertake investigations into these matters in tropical surroundings. In this connection the College offers advantages for the study of the method of production of tropical crops, and the nature and control of pests and diseases to which they are liable.

In the first session of the College eleven students entered for the three years' Diploma course, of these 5 were from Trinidad, 5 from Barbados and one from Jamaica. Four students attended post-graduate or special courses, one, a graduate from Cambridge holding the B.A. degree with the Diploma of Agriculture, took a special course in tropical agriculture; two, holding studentships from the Empire Cotton Growing Corporation, received special instruction in subjects connected with cotton production; these have subsequently received substantial appointments in Nyassaland at the instance of the Corporation. The fourth received special instruction in connection with cacao and other subjects.

The second Session opened on October 1, 1923, and the following students are now in attendance: ten students of the first year have entered on their second year and eight new students have entered for the Diploma course, making eighteen in all. There are six post-graduate students, two from Oxford and four holding scholarships from the Empire Cotton Growing Corporation.

The work of erecting a substantial block of buildings from the design of Major Corlette, O.B.E., is now in progress, the Foundation Stone of which was laid on January 14 last by His Excellency Sir Samuel Wilson, K.C.M.G., C.B., D.S.O., in the presence of a distinguished gathering; it is expected that this building will be completed by October of the present year. The building is of reinforced concrete and is to provide the administration offices, library and some twelve or more laboratories and class rooms, together with store rooms and ample common rooms and accommodation for men and women students.

The intention of the founders of the College is that it shall serve as an institution for scientific research as well as for teaching, and already a good deal of work of a research nature has been started and projects of considerable interest are being planned. The following particulars are taken from the first issue of the College Journal, "Tropical Agriculture," p. 12:—

In the Department of Chemistry present work includes: (a) an investigation of the manufacture of calcium citrate and citric acid, (b) extraction of pectin from lime fruit rind, (c) methods of preparation of nicotine from tobacco, (d) physical characteristics of types of tropical colloidal soils, on which work of fundamental importance has already been published.

In the Department of Economics the studies include: (a) a comparison of the cost of production of tropical produce in different stages of preparation; (b) the formulation of cost accounting systems for cacao,

coconut and rubber estates based on uniform principles and methods; (c) study of the economics of Trinidad and West African cacao industries, (d) study of tropical estate labour with reference to output, fatigue and efficiency.

In Entomology the following topics are receiving attention, (a) the relation of plant bugs to diseases of field crops, (b) studies in the interrelation of plants and insects (such as the sugar cane and the frog-hopper, (c) studies of insect association within the limits of a plant group, (d) the natural control of insect pests.

Mycological and bacteriological work includes (a) investigations of Panama wilt disease of the banana, (b) studies of utilisation of by-products (e.g.) exhausted molasses), (c) studies of the fungi of internal boll rot of cotton, (d) saprophytic growth of Phytophthoras in soil.

The Department of Botany and Genetics has a wide range of studies in progress which cannot all be enumerated in the space available; but the work on cacao includes method of pollination, resistance to disease, possibility of combining fine quality of Creollo with heavy yield of Forestero and Calabacillo; that with cotton the isolation of a new type of Egyptian Jannovitch; that with coconuts, a study of the natural yield and the application of genetic methods to increasing yield; that with sugar cane, the breeding of a variety resistant to mosaic disease.

In the Department of Agronomy and Agriculture distance planting experiments are planned; agronomic trials of bananas, weed control experiments and the study of rotations are in progress.

This list omits reference to special investigations relating to bananas which have been in progress for several months; these investigations include studies in connection with the Panama or wilt disease and other diseases of bananas, the assembling for purposes of comparative study of a collection of various types of bananas, and the raising of bananas from the seed in the hope of securing new types of commercial interest and importance and, more especially, of varieties immune or resistant to Panama disease. Some progress has already been made, and as the outcome of some 20,000 hand-pollinations 200 seeds were obtained last autumn, from which 13 seedling bananas have already been secured and there is the possibility of still more germinating.

Seeing that the College authorities only took possession of the land and began work on provisional buildings towards the end of March, 1922, only some twenty-one months ago, and that the College was only opened for teaching purposes a little over 15 months ago, I think it can be claimed that good progress has been made; I can bear testimony to the arduous nature of the work undertaken to bring the College into being and to ensure that it should be ready at the beginning of the Academic Year, 1922-23, and to the energy and zeal of those responsible for the work of organization, construction and teaching. It is hoped that, as the result of these efforts, the College is now well established and that its work of teaching and investigation will go on uninterrrupted for many years to come. Every effort is being made to maintain the work at a high level, to keep it of University standard so that it may be of the highest degree of usefulness, and rank with that of institutions of importance in other countries.

It is evident that the work thus planned and undertaken by the Governing Body will require much more money than the original endowments of the College will provide: an appeal for funds is therefore being put forward which it is hoped will meet with generous response on the part of the Governments of tropical Colonies and of

those connected with the agricultural and commercial affairs of the tropics.

During recent years when the establishment of this College has been advocated, much has been said concerning the need that exists for such an institution and the functions which it should fulfil. In the first place it is intended to give sound instruction to those who are to engage in the business of planting in the tropics, to enable them to carry on their work with skill and intelligence, and so to equip them that they will be able to take advantage of the discoveries of science and apply them in their work. It is also intended that the College shall afford instruction and training for those about to attach themselves to such institutions as tropical Departments of Agriculture, or who are about to become the advisers of planting and other concerns, thus furnishing a body of men who have received their training in the tropics and in actual contact with the crops with which they are concerned. It is obvious that great advantages should arise from the employment of men so trained, in preference to men who have had no experience or training within the tropics.

The College should, and doubtless will, prove of great value as a centre for research in matters relating to tropical agriculture and for general advancement of scientific knowledge; many problems relating to tropical agriculture have never been investigated and reliance has had, in many instances, to be placed on generalities based on observations made under the conditions of a temperate climate; experience proves that much of this information is not applicable to tropical conditions, and that further work in the tropics is necessary. Similarly, questions bearing on the pests and diseases of tropical crops require special knowledge, and there is abundant experience to show that these pests and diseases are frequently such that there is little information to be obtained concerning them until they assume prominence in connection with the development of some tropical industry; there are many instances to be found where the successful development of an industry has been retarded until new work has been done in order to ascertain the real nature of some trouble and to devise means of combating it. At the Imperial College of Tropical Agriculture information such as this should be available as the outcome of investigations carried on in advance of the immediate requirements of planters. Furthermore, it will be the duty of the College to investigate those points relating to pests and diseases of tropical crops wherein knowledge is so far defective, and to furnish information which should be of great service to tropical industries.

With teaching and research thus proceeding hand in hand the Imperial College of Tropical Agriculture should prove of world-wide benefit, commanding the sympathy of all who are interested in and connected with tropical agricultural industries and their development, and it is hoped that this will be manifested by liberal financial support from all—whether Governments, Corporations or private individuals—who are in any way connected with tropical affairs (applause).

"THE IMPERIAL COLLEGE OF TROPICAL AGRICULTURE."

BY

SIR A. SHIPLEY, G.B.E., ETC., Chairman of the Board of Management.

One would like to begin at the beginning but in the case of the Imperial College of Tropical Agriculture it is a little difficult to say precisely where that beginning lies. In one sense the whole enterprise

arose out of the Imperial Department of Agriculture whose headquarters were in Barbados. This had been established by the Colonial Office in 1899 with the twofold object of restoring the sugar industry in the West Indies and of encouraging other industries. The Department, under the able guidance of Sir Daniel Morris and later of Sir Francis Watts, and with the help of a competent staff of capable assistants was markedly successful. By a series of periodic publications, lectures and aid given to agricultural teaching in schools, it did much to raise the standard of knowledge amongst those in charge of the varied crops produced in the West Indies. In their difficulties the planters had one to whom they could go for advice, some one to help them with special knowledge. The Department brought in useful economic plants from other lands, and tested their suitability to their new surroundings. A most notable example of success in this direction is that of the Sea Island Cotton which shows signs of extermination in the States owing to the ravages of the boll weevil; by united efforts of the Department in Mycology Entomology and Economic Investigation, this valuable cotton has been established in Barbados, St. Vincent, Montserrat, and elsewhere. Dr. W. H. Himbury says —"The British West Indies are growing between 4,000 and 5,000 bales of the finest cotton grown in the world —the far famed Sea Island variety—double or treble the quantity could be grown, but unfortunately, owing to the depression at this end, there is sufficient produced to meet present requirements."

Good as the work of the Department had been, it had always been hampered by lack of adequate funds, and much of its work was necessarily executive and tended to become routine. Towards the middle of the last decade, even in the midst of the clash of arms, a movement was stirring to do something more for the West Indies and British Guiana, and to do it on a large scale. Enlightened merchants whose commercial interest lay in the Carribean Seas felt the need of more specialized and intensive study of the many problems that confronted them, and the need of trained brains to undertake that study.

From the earliest times the principles of agriculture have remained the same, and they are the same in the tropics and the temperate zone, yet how different in detail. Just as disease is disease whether in the heart of Africa or in the highlands of Scotland, yet its causation and its cure are widely different in these widely separated areas, so agriculture is agriculture all over the world, but when we come to deal with the produce of the soil in the hotter regions of the world the problems it present and the method of solving them require specialized knowledge and research.

A number of leading planters in Trinidad passed a resolution in favour of the establishment of an Agricultural College, and this resolution was passed on through the Governor to the authorities at home, and that enlightened statesman Lord Milner, who was then Secretary of State, appointed in 1919 a Tropical Agricultural Committee to consider the possibilities.

After many sittings and the taking of much evidence this Committee unanimously reported in favour of the establishment of the new College, and this was affected with little or no delay. Pending the presentation of a Petition to the King for a grant of a Royal Charter of Incorporation, the College was registered under the Companies Acts, and the License was dated the 2nd September, 1921, and this date may be regarded as the foundation date of the college.

The Staff of the Imperial Department became the Professors and their head the Principal of the new Institution This was no small sacrifice

on their part for it meant transference from the comparatively cool island of Barbados to the much hotter and damper climate of Trinidad. Plans were then drawn out for the new building but as much time was occupied in adjusting the views of the Governing body in London with those of the Executive Committee in Trinidad there was some little delay before the building could be begun. The Government of Trinidad and Tobago generously let to the College for one hundred and ninety-nine years at, as Mr. Montague Tigg would say, "The ridiculously small amount" of 1/- a year some 84 acres of suitable ground on the pasture of St. Augustine, 7 miles east of Port-of-Spain. The Governing Body purchased the Estate's residence as a home for the Principal, and a certain number of new houses were built for members of the staff. A disused hospital was refitted and converted into laboratories and lecture rooms, and here the College was formally opened by the Governor, Sir Samuel Wilson, in October, 1921.

Close to St Augustine lies the Government Stock Farm and the land where the Department of Agriculture carries out its large scale experiments. The site is full of historic memories, for it was through the orchard here that Sir Walter Raleigh and his men advanced when they burned the Spanish Town of St. Joseph in 1595, and obtained the pitch with which to caulk his ships. Here too is the drawing room of the residence "Valsayn" where, two centuries later the last Spanish Governor, Don Joseph Maria Chacon, signed the treaty of capitulation with the English representatives, Sir Ralph Abercomby and Admiral Harvey.

Placing the College in the island of Trinidad has given rise to a little comment and a little jealousy. But "after all," as Lord Milner said, "it has to be somewhere." Trinidad is the second largest island in the Antilles. Its soil is not only very fertile, but is very varied, and on it large crops of every kind of tropical produce are grown. It has population of just over 350,000 and its chief town, Port-of-Spain, is well supplied with such modern facilities as electric light, electric tramways, telephones, a good water supply, and an efficient drainage supply. A recent authority has stated that it is one of the most sanitary cities in the West Indies. Moreover, another factor played a part in the choice of this Island for the new experiment, and that was the generous offer of a very considerable subsidy to the College by the legislature of Trinidad and Tobago, and a very favourable site for the new College buildings.

The buildings designed by Major H. C. Corlette in the old Colonial Style are simple. The dignity of the facade is due to the fine proportion of the several parts. Of course in building laboratories there is always a fight between the staff who want an enormous window area and the architect who thinks that too much window spoils the design. In this case the Staff won and the rooms are all well lighted. On the ground floor is an entrance hall with the Principal's room, a lecture room, the library, and laboratories devoted to Physics and to Sugar Technology, with the Common Room and Office at the back The first floor houses the class rooms and the Botanical, Mycological, Entomological and Chemical Laboratories, and rooms for the Professors and women students. On each floor there are wide and spacious galleries on to which the roofs open. The building which will be completed at the beginning academic year has cost £39,000. On another site in the grounds a Model Sugar Factory will be built during the Summer. This has been made possible by the generosity of the British Sugar

Machinery Manufacturers who have given the College machinery and plant to the value of £20,000.

The Constitution of the College comprises (1) A Governing Body which meets in London and consists of a certain number of leading Londoners and Merchants interested in the British Tropics, and an equal number of scientific men some of whom are nominated by certain Universities. There is also a representative of the Colonial Office and representatives of the participating colonies, who can, of course, only attend on the rare occasions when they are visiting home. (2) The Executive Committee which meets in Trinidad. This consists of the Senior Financial Officer of Trinidad and Tobago, and the Principal and six other Governors resident in the West Indies. (3) An Academic Board comprising the Principal and the Professors, which deals with the course of studies and matters of discipline and corresponds with the Governing Body through the Executive Committee. Of course difficulties arise from time to time owing to the 4,000 miles which separate the Governing Body in London from the Executive Committee in Trinidad, but these difficulties have so far been few and far between, and on the whole the arrangement has worked with a minimum of friction.

The financing of this new College has necessarily been a matter of anxiety to the promoters. The Imperial Government has contributed a grant of £15,000 to be spread over a period of 5 years. This will cease in 1927. This is conditional on the College carrying on the the functions of the Imperial Agricultural Department. The Colonies of Trinidad and Tobago, Barbados, the Windward Islands and the Leeward Islands have generously granted subsidies of one-half of one per cent—a formula now very familiar to the inhabitants of the United States—of their average revenues of the last three preceding years. Handsome contributions have also been given by Dr. J. W. Stephens of Trinidad, Messrs. Cadbury and Fry, the British Cotton Growing Association and from other sources. The fees are purposely kept low, the tuition fee for the diploma course is but £50 a year, whilst contributing colonies and industries may nominate a limited number of students without any payment of these fees, and other students from the same sources are admitted at one half the normal rate. Thus the College cannot look for much help from the Student's contributions. No student who has not reached the age of seventeen is admitted, and those reading for the Diploma must pass an Entrance Examination whose standard is about that of the Matriculation Examination of any British University. Exemptions from this test is granted to those who have passed an equivalent examination elsewhere. It is refreshing to find in a College devoted to such a specialised and technical subject as Tropical Agriculture that in "all the classes attention is given to the speaking and writing of clear, concise and grammatical English." The course of the Diploma extends over three years of three terms each, and covers a very wide range of subjects. It is planned so as to give a training to "those desirous of following the business of tropical planting and those who wish to obtain expert knowledge in various branches of tropical agricultural technology." Students who are already trained in the theory and practice of Agriculture generally are admitted for shorter periods and can attend lectures and classes in the purely tropical aspects of that science. It is further hoped that from time to time the planters and their managers may visit the College for quite short periods to acquaint themselves with the latest developments in the culture and management of the crops they grow.

Special stress is laid on the promotion of research, and the list of Scientific papers written by the present staff whilst members of the Imperial Department justifies the belief that this most important part of the work of the College will be maintained at a high level. The recent publication under the auspices of West Indian Committee of *Diseases of Crop-Plants in the Lesser Antilles* by Mr. W. Nowell is proof that the work of investigation into the plant diseases of the Tropics has been, and is being successfully pursued. The Author, at one time Mycologist to the Imperial Department is now Assistant Director of Agriculture in Trinidad and Tobago and here perhaps it may be mentioned that the relations with the Department of Agriculture under the Directorship of Mr. W. G. Freeman are most cordial. He and his colleagues have been most helpful to the College. As one example, out of hundreds of problems which confront the researchers at the College we may take the Banana Wilt or Banana Disease. First noted twenty years ago in Panama, within a few years it has destroyed the crops on tens of thousands of acres in that Republic and the neighbouring country of Costa Rica. By 1913 this devastating fungus had virtually ruined the recently established banana industry in Surinam, and British Honduras was heavily infected. Jamaica is also suffering, and in fact the disease seems to be established in almost all countries where the fruit is grown, India, Australia, the Hawaiian Islands and elsewhere. An effective control of the fungus, which enters the plant from the soil and attacks the vessels of the root-stock, would prove an enormous boon to the planters throughout the world.

The College though situated in the West Indies is Imperial in inception and in purpose. It hopes and intends to train agriculturists for all those parts of the Empire which lie within the tropics. It wants to be the "John the Baptist" of Colleges-to-be, the forerunner of other institutions in all the hotter dominions of the King that lie beyond the seas. It has a further great ambition and that is to advance knowledge. It fully realizes, as in the great times of Queen Elizabeth, Francis Bacon realized, that there is a new unexplored Kingdom of knowledge within the reach and grasp of man, if he will be humble enough, and patient enough, and truthful enough to occupy it (applause). We want the College not only to be worthy of Trinidad, of the West Indies, but worthy of the Empire. (Applause.) Whatever influence you have I would ask you to help us—not only by monetary contributions but general help. One of the most striking communications which we have received is from Dean Holt of Trinidad. He offers to make an annual collection in his church towards the funds of the College and asks whether such contribution would be accepted. (Applause.) The President had informed him that it would be acceptable. That is a fine spirit—a spirit which I should like to see continually displayed in connection with the College. (Applause.)

"THE NEED FOR AGRICULTURAL EDUCATION IN THE WEST INDIES."

BY

J. R. Bovell, I.S.O., etc.

Mr. President and Gentlemen: As I have been connected with Agriculture all my working life and so have had many opportunities of seeing the need there is for the training in agriculture of the young men

who propose to become planters, I will first briefly state why in my opinion there is such a need.

I have seen the need for this training for a long time. I may mention that in writing to Sir Daniel Morris when he was the Assistant Director of the Royal Gardens, Kew —long before he was appointed Imperial Commissioner of Agriculture for the West Indies—I stated that I thought an Agricultural College was badly needed in the West Indies and I even suggested that it should be established in Trinidad. The reason may be asked why I suggested Trinidad, instead of, say, Barbados or Jamaica. It was because Trinidad is out of the hurricane zone, and so it is not likely that the work of many years on—say the manurial requirements, etc., of permanent crops, like cocoa, coconuts, limes, etc., would be lost in a few hours by a hurricane. To give an instance of what I mean, I may say that I understand during the last hurricane in Jamaica one of the eastern parishes lost 90 per cent. of its coconut trees. Now it takes many years before the trees on a coconut estate can be said to have reached maturity, and some time before their actual manurial requirements can be ascertained, in all say about twenty-five years. In this case had manurial experiments of coconuts been carried on in that parish in Jamaica the results of about twenty-five years' work would have been lost in a few hours. The same thing would occur with cocoa and other crops like citrus fruits, etc. Barbados is also in the hurricane zone and there is practically no land suitable for cocoa cultivation, and very little for coconuts.

To give a few instances showing the need there is for agricultural education in the West Indies, I may state that many years ago a proprietor of an estate in one of the West Indian Islands, sent out a Fowler steam plough. This estate was rather a level one and a great deal of the land consisted of a heavy clay loam. Those in charge of the estate considering that they were doing the best thing possible for the estate, set the plough to turn over the soil to a depth, as far as my memory serves me now, of about twelve or fourteen inches. The result was that the bacteria in the surface layers of the soil were buried too deeply and the poor soil from underneath with practically few bacteria, was brought to the surface, the consequence being that the sugar canes could not grow. As is well known, to put it briefly, no bacteria in the surface layers of the soil, means no crop, as these organisms prepare the food for the assimilation by the roots. As an experiment, a ton of soluble Peruvian guano was applied to an acre of this land but practically without result, and it was many years before satisfactory returns were obtained from some of those too deeply ploughed fields. I have known the part proprietor of an estate to import for the use of the estate a Fowler steam plough. His partner refused to use it knowing as he did the result of the experiment referred to above. This plough was not used and it was allowed to remain and rust, until the estate was purchased by another man. The new proprietor who is a very intelligent and successful planter had the plough cleaned and put to work, only going to about half the depth in the instance I mentioned first. This planter has got excellent results showing that it was not the fault of the plough in the first instance, but the want of knowledge on the part of those directing its use. If they had been students who had passed through an up-to-date Agricultural College, they would have known better than to have buried the surface bacteria so deeply and to have brought the practically sterile soil to the upper surface, and the estate instead of losing heavily would have made considerable profit from the fields properly ploughed. To give another instance of the

harm done by burying the surface bacteria too deeply, I know of an incident where a planter in Barbados was moved from what is known as a black soil estate to a red soil estate in a district where there is a great deal of heavy red clay. On assuming charge he commenced to plough a field with a mouldboard plough turning the land over as deeply as he could. A neighbouring planter who had lived in the district for some time pointed out to him the mistake he was making and suggested that he did one half of the field as he proposed and closely subsoil the other half. This he agreed to do and when the canes were grown the difference could be very clearly seen; the portion of the field that had been buried by the mouldboard plough being much inferior to the other half that had been closely subsoiled. Here again was a case of loss occurring from want of agricultural education. Instances such as those I have given above have caused men who are ignorant of the principles of agriculture to say that ploughing is of no value, and that the right place for ploughs is the "old iron heap." These instances have also had a bad effect on a number of people who saw the ploughing done and the results, without knowing the reason why the crops were bad.

That I am not singular in my opinion in respect of the undesirability of burying the upper layers of the soil and bringing to the surface the subsoil, I may mention that Sir E. J. Russell of Rothamstead, in his book on "Soils and Manures" states: "Sixty years ago it was thought that the subsoil was really the virgin soil, rich in stores of food that only needed liberating by the action of frost. Sixty years of experiments have shown that as a rule this is not correct, the subsoil is really very poor in plant nutrients and nothing whatever is gained by bringing it to the surface. Considered as a manure it is despicably poor." Sir John Russell also states: "Indeed many acres of land have been ruined by deep steam ploughing which has buried the surface soil and only left the plants with a sticky unkindly subsoil."

To show again where the want of knowledge occasioned considerable loss to a big plantation—some years ago a manager of an estate in a district where the soil was not very deep and where the canes were ratooned, dug fairly deep cane holes with the result that the crops grown were good ones. As he did well on this estate he was promoted to a large estate in another district in which most of the land was to a great extent heavy clay loam. On assuming the management of this estate he dug similar cane holes to those he had dug on the estate he had just left. The result was that during the rainy season the water settled around some of the clumps of canes and remained there in some instances until algae grew in it. As the sugar canes were unable to respond to the application of chemical fertilisers more and more were given them, until I heard that $33.00 worth per acre had been applied but the estate produced about half a crop. In this case the loss was about 300 tons of sugar, which, at say £15 per ton, was worth £4,500. I think it was the year after the proprietor of the estate came out to the West Indies. On meeting him he told me that on going around his estate with his Attorney and Manager, they came to a field of sugar canes which looked very yellow and stunted. The Attorney at once reprimanded the Manager for not asking him for sulphate of ammonia or nitrate of soda for it. The proprietor was a graduate of an Agricultural College so he knew that some enquiry ought to have been made before the condition of the sugar canes was attributed to the want of nitrogen, he therefore proceeded to make enquiries and he found that over half a ton of sulphate of ammonia, equal to about 225lb. of nitro-

gen per acre, had already been applied to the field. It was therefore evident that the condition of the sugar canes was not due to the want of sulphate of ammonia or nitrate of soda.

On one occasion I was taken by a planter friend in one of the West Indian Islands to see a field which was being prepared for sugar canes. Diseased ratoon sugar canes had been allowed to remain on the field until the planting season, when the best of them were made into cuttings for replanting the field; the ratoons, stools and fallen leaves were ploughed in and those diseased cuttings planted. In another instance I have seen land similarly treated in the month of January, that is, the old stools and debris from the diseased canes that were growing, ploughed in, and cuttings for replanting made from some of the better of those sugar canes. And the worst of it is, this method of working is not restricted to any one island, as some planters still consider that any sugar cane is good enough to make cuttings from for replanting their estates. To give another instance. A man who knew what a mistake it was to plant diseased cuttings saw the manager of a friend's estate buying cuttings of diseased canes for planting, so he obtained a couple of these diseased cuttings, showed them to his friend and suggested that he might use a little gentle pressure and prevent such cuttings from being planted All he got for his pains was the remark that "they would grow."

I am glad, however, to say that in many instances now, at all events in Barbados, very much better cuttings are used for planting purposes, and most of the up-to-date men use some of the best of their plant canes for making cuttings, but still there are a number of planters who use cuttings attacked by fungi and insect pests for planting purposes. I think it is well known now in almost every country where sugar canes are grown the more up-to-date planters are making efforts to get varieties of the sugar cane giving high yields, produced either in their own countries or from countries where better varieties have been grown for planting purposes.

At one time the practice prevailed in Barbados of cutting out what is known as mother plants, i.e., the most vigorous shoot, sometimes two, in each clump of sugar canes. The reason given by those who did so was that it caused the clumps of canes to tiller, not, I presume, realising that the material from which the young sugar cane is made is manufactured in the leaves and if they destroy, if I may so describe them, the best of the factories for manufacturing this material they were doing irreparable harm to the clump of canes.

One year at Dodds after cutting out all the dead hearts attacked by the moth-borer in one field, I had, in addition the mother plants of every alternate four rows cut out. On testing the results we found that where the mother plants were not out there were 2,070 canes more per acre—weighing 3.7 tons— than where the mother plants were cut out. This at even £1 a ton would be equal to £3 14s. per acre which was lost and which would have been practically all profit.

To ascertain what happened when a mother plant was removed on one occasion I cut out nine mother plants from nine different holes of canes. A fortnight after cutting out the first six, I had three of the clumps of canes dug up, and in nearly every case the cut ends of the canes had a fungus growing in them, and beyond the fungus there was a red discoloration of the fibrovascular bundles extending through the piece of severed mother plant and passing into the shoots which had grown from its side buds before it was cut out. In addition to this fungus, four of the remaining pieces of mother plant contained

larvae of the lady bird beetle (*Sphenophorus sericeus*, Oliv.). One stool had two, one had three and the two others one each of these pests. When examining these stools I also looked carefully to see if cutting out the mother plants had caused any new suckers to be formed, and only in two instances had fresh ones started into life where the mother plants had been cut out.

It was also customary at one time to cut out the dead hearts, i.e., the shoots which had been killed by the larvae of the moth-borer. Here, too, the fungus gained an entrance into the base of the shoot and passed to the other shoots, whereas if the dead heart shoots are allowed to remain there is formed at the base of the killed shoot a callus which prevents the entrance of the fungus. On one occasion a doctor friend of mine was good enough to have an experiment carried out on his estate to ascertain whether there was a loss or gain from cutting out dead hearts. In this case the dead hearts of half of a field of young canes were cut out and those in the other half allowed to remain. Each half was reaped separately with the result that the loss from cutting out the dead hearts amounted to 672 lbs. muscovado sugar per acre.

To give another instance of the need for Agricultural Education in the West Indies I may mention that when I first grew sugar canes from seed in Barbados a member of the House of Assembly, who was a planter, warned the Government from his place in the House that they were allowing me to ruin the island, stating that I was growing sugar canes from seed and that before long these canes would get mixed up with the Bourbon and they would all be ruined. Fortunately, a graduate of a University who was present pointed out the nonsense he was talking and the matter dropped. I am quite sure that if that planter who said the growing of new varieties of the sugar cane from seed had had a three-year course at an Agricultural College, he would not have given expression to such an opinion.

Not only is there need for the teaching of Agriculture proper but there is also great need for the treating of, if I may so express it, cognate subjects. To give an instance or two I may mention that I knew of a planter who said he "always liked to see plenty of smoke coming from the sugar factories as he knew something was being done," not realising that smoke was unconsumed carbon principally from megass and that so much organic material was being lost which could have been put to a better use, by being rotted and applied to the land.

Then there is the subject of economics. I fear at the present time very few planters keep any itemised accounts of the cost of producing the different crops, or the comparative values of the various foodstuffs they purchase for their animals, or how they should be rationed. Not long ago a planter who belongs to a scientific profession informed me that he found that, as he was feeding residual vacuum pan molasses to his animals he could, owing to the carbohydrates it contained, save money by ceasing to buy a certain foodstuff that contained a considerable percentage of carbohydrates, in addition to a fairly high percentage of protein and to buy a foodstuff richer in protein and lower in carbohydrates. On going over the matter and basing my calculation on the starch equivalents in these foodstuffs I found that apart from the fact that he was buying carbohydrates which he did not need he was paying 29 per cent. more for protein, carbohydrates and fat in the foodstuffs he discontinued buying than he was paying for in the foodstuff he continued to buy, i.e., he was paying $129.00 in one foodstuff which he could obtain in the other for $100.00. As this planter owns

several estates and so purchases a considerable quantity of food for his animals it made quite a monetary saving to him.

There are many other instances I could quote of the loss obtained in the West Indies through want of knowledge on the part of a number of the agriculturists but I have, I think, said enough to show that there is without doubt a great need for agricultural education in the West Indies. Before, however, closing there are one or two matters in connection with this question that I should like to emphasize and these are:—

The desirability of making the course at the Imperial Agricultural College as practical as possible, if the graduates are to succeed when they leave College. If that is not done they will find it very hard to get employment from the majority of the planters who are in so many instances ignorant of the principles that underlie scientific agriculture. These men will not employ them if they can possibly help it, because they will think that the graduates will be laughing at them behind their backs when they talk nonsense. If they do employ them and they find that they do not know the ordinary estate methods they will stigmatize them as "useless and the College a farce." To a great extent one can sympathise with these would-be employers. What they will maintain is that they want a man who can assist them with the ordinary estate work, a man who knows how cane holes should be dug, land drained, drains dug, etc., not a man who could make an analysis of a soil or a manure, work out the life history of an insect pest or cultivate a fungus and ascertain whether it was parasitic or saprophytic on the plant on which he found it. Further, to do these things, would require the establishment of, and maintenance on the estate of, a laboratory, the expense of which would in most instances be out of proportion to the size of the estate. Besides, in most of the British West Indian Islands arrangements have already been made for carrying out such work, the cost of which is borne by the general revenue to which everyone contributes and from which everyone benefits.

Personally, what I should like to see would be an area of, say, five or six hundred acres of land attached to the College which should be conducted as a commercial undertaking quite apart from the area used for experimental purposes, on which the students should be taught their work as practical planters. The majority of these students are not going to gain their livelihood by being entomologists, mycologists, or chemists, and while they should know sufficient of these subjects to be able to understand and realize the importance of carrying out the recommendations of the specialists in the subjects mentioned above, their duty above all things is to realize that the working of an estate is a commercial proposition, and that the first thing is to make an estate pay, and not to learn their work as planters at the expense of the proprietors.

Just after the above was written I received the Journal of the Ministry of Agriculture, Great Britain, for December, 1923, in which there is what is described as the substance of an address given by Sir A. Daniel Hall, F.R.S., etc., Chief Scientific Adviser and Director-General of the Intelligence Department of the Ministry of Agriculture, to the Agricultural Education Association at Aberystwyth on the "Teaching of Agriculture." I was very pleased indeed to see from this address that such an eminent authority as Sir Daniel Hall takes practically the same view as I do on the subject, viz., that sufficient importance is not attached to teaching the practical side of agriculture. The address is

so pertinent to the question that I hardly think there is any need for me to say anything further in the matter, beyond advising anyone who has anything to do with the teaching of agriculture to read it. I will, however, just briefly refer to one or two statements he makes, for instance, under the sub-head "The Object of our Teaching" he says: "Let us begin by asking ourselves what we are after when we are dealing with the young men in an agricultural college. What is our object—what are we going to try and turn out? I think it is agreed that we are not thinking of turning out teachers, officials, or that kind of men; we are thinking really of turning out a thoroughly equipped farmer under modern conditions, and how we can help to ensure that type of man by education?"

Further on, speaking about the raising of crops and of live stock he continues: "It is in that connection the College Farm is going to be the most useful for the purpose of the teacher. The College Farm should be run as a practical business proposition, which is illustrating management and which is a text-book of the teacher in the lessons he is giving."

Where he says that the College Farm should be run as a practical business proposition, I have said that students should be taught to realize that the working of an estate is a commercial proposition, and that the first thing is to make an estate pay, and not to learn their work as planters at the expense of the proprietors.

The President: We have listened with a great deal of interest to the papers read by Sir Arthur Shipley and by Mr. Bovell. The latter paper shows how bad produce comes about through insufficient knowledge and how sufficient knowledge would be obtained through the development and support of the college which we have been speaking about to-day. I do not know whether anybody else would like to speak about the College, and if not we will listen to the address of the Hon. A. E. Harrison, Custos for the parish of St. Elizabeth, on "Our Educational Problem."

"OUR EDUCATIONAL PROBLEM."

BY

THE HON. A. E. HARRISON, B.A.

Mr. President, ladies and gentlemen: I have listened to so many interesting discussions this week on the various forms of plant life and insect life and the diseases that attack them, but there is one species of animal life—a highly resistant organism known to the scientific world as the Genus Puir—to the man in the street as the human body—he is troubled also like the plants with many forms of disease. The special bacterium that attacks this species is the "Bacterium Magistrum." Like the Java cane he is highly resistant but easily infected with the bacterium and in turn he spreads the "Bacterium Magistrum" culture to the generation after him.

It is with great diffidence that I venture to read a paper before your conference on a subject so vast as our educational problem. But I am encouraged to do so as I feel sure that our educational difficulties in Jamaica are common to other West Indian Islands. In order to find a solution to a problem which has baffled the men of all times we require the services of the perfectly wise man with long experience who has been able to make himself the complete master of the psychology of

the race whose education he is considering, and if we had the perfectly wise man we should require next a people and a Government wise enough to take his advice.

It is generally agreed, however, that education is more or less a biological process and that a people can only profit by educational methods in proportion to their own previous training and environment. In other words, education is one of the natural processes of evolution. Any forcing process must eventually end in failure.

It is also agreed that education is a human need and that every human being is anxious to supply that need. When therefore we talk of compulsory education we are really introducing a forcing process of doubtful value and yet it would seem as if this is often introduced as the panacea for every ill.

In theory our present educational system in Jamaica is most excellent, but we are beset with many difficulties in carrying it to a successful issue. It has been recognized that there is great value in the mechanical arts of Reading, Writing and Arithmetic, and of late years much good work has been done by work in school gardens to teach the child to observe and proceed from established facts to new ideas, but we are met on every side with such difficulties as lack of funds, understaffing and also with what is considered the greatest difficulty of all, the impossibility of removing the children from environment which does not tend to improve them. The Educational Report of the Colony tells its own tale. During the year ended December, 1921, there were 96,000 children on the attendance registers of the Elementary Schools, 12,000 of these were between the ages of 13 and 14, while 84,000 were between the ages of 4 and 12. Of this number, 30,000 are children between the ages of 7 and 8 and the greatest number at any particular age are the children of 8—about 16,000 are this age, that is 16 per cent. of the children at our elementary schools are 8 years old and 30 per cent. are between the ages of 7 and 8. On the other hand, 3 per cent. only of the children are of the age of 14. This means that the teacher has to devote his attention to very young children of 7 and 8 at an age when they are scarcely capable of profiting by the very elementary education they receive, while he can only get hold of 3 per cent. of the children of 14, who should be capable of understanding better than the eight-year-olds what he teaches them. Furthermore, the children of 8 are generally to be seen sitting outside the schoolroom door under a tree in charge of a pupil teacher and keenly alive to the interest of every passing vehicle or pedestrian. If we also remember that only two-thirds of the children on the registers actually attend school it will be seen that only a very, very small number of the children of this island are attending school at the age of 14. In spite of every effort on the part of the teacher and the Educational Authority, it is extremely difficult under these conditions to produce an educated peasantry.

There are some who would say that the people do not appreciate the efforts made on their behalf to educate them and without doubt the indictment looks very bad. Still, if we bear in mind that there is no continuity in the education given in our elementary schools, and that after arriving at the VIth Standard the child has as it were graduated there is a great temptation for the brilliant ones to retire as soon as they reach this happy position, and for the others to give up the fight a little earlier in their career to turn to their natural work on the land.

Compulsory Education has been suggested as a remedy against this state of affairs, but others think that compulsion is antipathetic to the psychology of the race and another suggestion is that we should hold before our young people the chance of continuity in their education and along lines that would appeal naturally to them. This is without doubt an agricultural country, and the natural processes that should be encouraged are the processes of agriculture, and by this of course it should be understood that Scientific Agriculture is meant. In the old days the young people of this island were anxious to be apprenticed to learn trades, but of late years there has been a gradual but general falling off in this direction, so much so that it is with great difficulty in the country parts that we can get satisfactory tradesmen carpenters, masons, plumbers, blacksmiths and the like. It is not to be thought that our people have any rooted objection to work in these trades, they are naturally hard workers in their own fields. It would then seem as if the time were ripe to ask the Government to set the machinery in motion to help if possible the further education of the young of this island.

We need a driving power behind Elementary Education that shall not only be a stimulus but shall also produce the greatest good to the greatest number, and increase the potential value of the present system of Elementary Education in the island. We have to bear in mind that our revenue is limited but money invested in the uplifting and in the increasing of the value of the man-power of the country will produce the most reproductive work that we can have. We want our youth to appreciate the value of the elementary education they receive and to realise that it will lead them on to fuller citizenship, and to do this we must afford them some chance of continuity. If it resolved itself into a question of funds the younger children in the island might well be left in the hands of their parents if we could get the parents to understand that early neglect would result in later loss. But if the State considered that it should take an interest in the very young children up to the age of 8 years, should we not rather see that they have good bodily health before they enter our elementary schools? Should we not rather take into consideration the question of the Health of the young child and would it not be an advantage to have these children thoroughly examined by our Medical Officers of Health at periodic times with a view to securing that mental efficiency that is such an important product of a healthy body? And in this case it might be advantageous to raise the earlier age in the elementary schools to 9.

If there were funds Infant Schools could be established to take of the very young, but however zealous the advocates of the early age limit may be, they must all agree that when we do get the children to school every effort must be made to keep them there during their School Life, and this is the defect we have to find some means of remedying. Above all things we must be able to keep our grip on the children between the critical ages of 13 and 14. We can make Laws to compel them to come in—we can fill our Schools Registers—we can over-tax the Training Colleges to produce the necessary staff—we can spend large sums of money, but we cannot educate the child unless we can rouse his ambition and enthusiasm so as to give him an initiative to work so that he co-operates with us. Better far to my mind is the silken thread of ambition than the iron hand of compulsion. The hope of reward which stimulates ambition has proved its value in many walks of life other than education. I think we ought to throw

down a challenge to our youth—a challenge to climb the ladder that leads to success

Let the children be afforded the opportunity of winning scholarships at their schools between the ages of 11 and 12. This would provoke a healthy competition not only among the boys but also among our teachers. Hold out the light to our boys and they would follow with wonderful zeal. The education authority has not failed to give this scholarship question some consideration, and there are at the present time a certain number of scholarships awarding free places in our Secondary Schools by means of which theoretically the boy from the elementary school can climb the educational ladder but he goes to the Secondary School from a school in which the curriculum is based on altogether different lines from that of the Secondary School. He has done no Latin or French or Mathematics and he therefore starts with a severe handicap so that he seldom succeeds in winning his way to the top of his school and so being able to sit for any of the more important scholarships that can provide him with a University career.

This is an agricultural country and its future lies in agriculture but "with a pertinacity worthy of a better cause" we have made very little effort either in the Secondary Schools or in the elementary schools of the island to direct education in agricultural channels. Boys infected with "Bacterium Engineerium" 99 per cent. want to become engineers Not long ago a distinguished English Headmaster wondered whether there would be enough engineers to go round, and it is the same in Jamaica. Following the lead of a highly industrial country like England we have moulded all our educational methods on the English system which is excellent in itself, but we have, I fear, lost sight of the fact that we are an agricultural country situated in the Tropical Zone. The establishment of the Imperial College of Agriculture in the West Indies shows that at last we are waking up to our needs, and this West Indian Agricultural Conference here should unfurl its flag on behalf of agricultural training in these tropical possessions of the Crown. The time is now ripe for the establishment of good, sound first class agricultural schools carried on on the best lines for boys from the ages of 12 to 18—agricultural schools carried on on the same lines as the best Secondary schools. In suggesting that we should inaugurate the new era of agricultural training by the establishment of agricultural schools and in introducing the subject in connection with elementary education, here is no intention of keeping out the boy from the Secondary School who would find it worth his while to continue his education here. I would like to see really first class agricultural schools established in suitable localities where large holdings could be procured. There seem to be two excellent sites now in the possession of the Government where the first schools could be started—one at Hope and one at Grove Place in connection with the Government Stock Farms there. (Applause.) The country has been not unmindful of its need, but it has heretofore lacked the machinery for staffing these schools efficiently, but now with the Agricultural College in our midst, we should not be slow to make arrangements to have our own men trained, and also to secure efficient men from abroad to undertake the training necessary in these agricultural schools. I feel sure that the Imperial Department of Agriculture would interest itself in seeing that we started on the best and broadest lines. It is to this class of agricultural school that I should like to see the most promising and the brightest and the most intellectual of the boys in

our elementary schools proceeding by means of Government scholarships, taking their places by the side of the boys from Secondary Schools, the nucleus of that army who will s t out to fight and conquer their agricultural problems as they meet them on the spot, and who will increase production in Jamaica so that her lands will more than yield in increased revenue any expenditure incurred in the cause of agriculture. Thes agricultural schools would of necessity be boarding schools but that would be a great advantage, as in the atmosphere of the boarding schools there would be built up as the years go on that invaluable tradition that would make for their success. There would be of course considerable expense in the erection of the schools and also in providing the necessary accommodation for the pupils, but if we built these schools as simply as possible with bungalow barracks, and if we sought utility rather than ornate architecture and were content with a picturesque rustic simplicity, the cost of these buildings for agricultural schools need not prove prohibitive. Either in connection with or in addition to the agricultural schools located in towns we should have trade schools for those boys in the elementary schools where they could learn trades. This would produce a class of artisan much needed in Jamaica, scholarships being awarded to these schools as in the case of agricultural schools.

I venture to prophesy that if action were taken on these lines we should have, without any necessity for compulsory education, a real enthusiasm aroused among the people of this island for education and our elementary schools would have no lack of pupils. It is to make a plea for increased educational outlook for the boys of the elementary schools of the island that I trespass on your time in throwing out these suggestions. But whatever efforts we make here in agriculture we must not lose sight of the fact that at last we now posse s our own West Indian Agricultural College, the Imperial College of Agriculture, a College obtained after strenuous effort on the part of those who have the interests of the West Indies at heart The doors are now open and it is for us to claim our heritage in that College. It requires no great strength of vision to see that in a very few years that College, now in its infancy, will stand out in the Western Hemisphere as the greatest Tropical College of Agriculture in the Empire. It is in the interests of all the West Indian Islands to see that this College develops as quickly and as soundly as possible. It is not altogether unfortunate that the site for the College was chosen in Trinidad and not in Jamaica. It is true that at the moment there are difficulties of transport, but this is an Imperial matter and will not be allowed to present any grave difficulty to the development of the College. In other respects it will be an excellent opportunity for ou boys to ravel away from home and to get down to Trinidad to rub shoulders with their brothers from the other islands. They will also be nearer to that continent on which it is their destiny to win to high positions after receiving English Diplomas of Agriculture at the College. We in Jamaica, knowing little of the initial small errors of the Coll ge will have a better and truer perspective of its work, and this will help us to encourage our boys to take advantage of what is a really splendid opportunity. The West Indies owe a great debt of gratitude to the Imperial authorities who have been instrumental in founding this College and it is a great privilege to us that we have been asked to contribute towards carrying on the work of this College. This is no dole on our part but money well invested which will bring untold benefit to the West Indian colonies. I should like to see Jamaica offer

a big endowment instead of an annual payment. The College wants the money now. The foundation stone of the College building has now been laid, but it is to be hoped that the authorities will realise the importance of making this College a residential College. It is essential for the purpose of discipline that the students should be in residence. In the future when her class-rooms and her lecture rooms are flooded by students from all parts of the great Tropical Belts of the Empire she will, I hope, be independent enough to be able to send off her own off-shoots. It is not within the function of this paper to discuss the arrangements that may be ultimately made between the authorities of the College and the various West Indian Governments, but it is safe to suppose that there will be some uniformity of action and it might be advisable that the question should be considered by a committee of this conference Apart, however, from any home scholarships that may be awarded to enable boys to go from their own islands to the College, it would provoke considerable friendly competition among the islands if the College offered an open scholarship on University lines, to be competed for by all the West India islands. A scholarship of the kind would certainly fix the attention and interest of all the Secondary Schools in the West Indies on the work of the College. We want to attract to the College the very best brains in the West Indies: and if I may still make a still bolder suggestion to the authorities of the Agricultural College, I would venture to ask them to consider the advisability of appointing in each West Indian Island at least one man who would represent the interests of the College in this island and be called in conference when necessary to consider questions affecting Agricultural Education and its relation to the College in the West Indies. Every effort should be made to secure the greatest amount of co-operation between the West Indian Colonies. This College should prove one of the strongest links in the chain of Federation of the West Indies. (Applause.)

On the question of Agricultural Schools, I suggest one at Hope and one at Grove Place. Now is the time when the people must make up their minds to move, and have these Agricultural Schools. We cannot go into the question of Scholarships now.

Capt. Hill said: I appreciate very much Mr. Harrison's paper and as one of the Governors of the College appointed by the Secretary of State, I will take home with me a copy of the paper for the use of the Governing Body, and I am sure that it will be of value, because the suggestions put forward are really fundamental and lay at the root of the matter, with which we are trying to deal Mr. Harrison has dealt very clearly with the training of the boys here on agricultural lines, and sending away the really efficient ones to perfect their training, and make them valuable teachers, and so keep the circle of instructions which is essential to the welfare of a great agricultural community, such as we have in this and the other West Indian islands. The Imperial College is looked upon from different aspects; I look upon it in a different way because of my being Director at Kew. I size up students not so much on what they know, but on their capacity to unlearn what they have learned at their homes, and how they adapt themselves to the new work. What we want and what we now have is a place where students can go and learn and apply themselves to the work to be carried out. We now have a place where these young officers can go and get proper training, and if they can mix and work with other students, they are getting all the value of "rubbing together" of the one

"coming up" and the one "coming down", which is going to be of actual benefit. As a member of the University of Cambridge, I can speak with some knowledge of the value of living in College, and of "rubbing together"; one cannot estimate its value too much. Lectures and all that kind of thing are very well in their way, but what makes learning of value is the intercourse with fellows which cannot be got anywhere else, and if Jamaica can see its way to throw in its lot with the College, I think she will be putting her youths where their education will be fostered, and I feel sure that Mr. Harrison's suggestion will be one of the first things the Governing Body will have carried out.

The President: Mr. Harrison's paper is extremely valuable. It has set out clearly the whole system of education in this island; he has envisaged the whole scheme of education in its proper light. Mr. Harrison has made reference to the desirability of establishing something in the nature of a farm school which will be attended by students of elementary and secondary schools, and scholarships in the Imperial College. That no doubt is the right line to take, and it is hoped that Jamaica will see it in that way. I am sure that West Indian Scholarships will be an attraction, and that there will be a great deal of competition for the scholarships, which will be useful. I see no reason why hostels should not be established in connection with the Imperial College, and it is hoped that if Jamaica sees its way to assist the College, there will be hostels. Mr. Harrison has referred to representation of the College in each island. There are a number of representatives to whom reference can be made; but it is a little unfortunate that the Windward Islands can only have one representative. The question of appointment of local representatives in the several islands is one for consideration; It seems to be a good thing to have these representatives who will be kept posted in the affairs of the College. One or two references have been made to a College Farm. Undoubtedly a College Farm is essential, but the College is only twenty-one months old, and it is a little bit too soon to run such an expensive organization as a farm. When money is forthcoming the College Farm will be there. Every one recognizes the necessity for the farm and I am sure that steps will be taken early to have it. I think that the progress of the College is well grounded and that with adequate support it will go ahead with its useful work in a great many directions.

Mr. R. S. Gamble was next asked to read his paper on "Commercial Problems of Agriculture in Jamaica." Before proceeding he said:—Although I am one of the Delegates of the Jamaica Chamber of Commerce, I should like it to be understood that any observations I make here to-day are entirely on my own responsibility and do not specially represent the views of the Chamber of Commerce. Our problems are always debatable and no doubt theirs may differ from what I have to say.

"SOME COMMERCIAL PROBLEMS OF AGRICULTURE IN JAMAICA."

BY

R. S. Gamble.

Others having dealt especially with cultivation and production of the more important products of Jamaica—bananas, sugar, cocoa, coconuts—I propose to deal briefly with some other problems with

which the planter and cultivator have to reckon, if they are to secure the best results for their enterprise, risk and labour, such as the possible protection from the effects of hurricane by insurance till crops are reaped and marketed, choice of markets, and means of reaching them, and transport.

Jamaica is specially fortunate in having been found so well fitted for the production of bananas, and having had a powerful organisation to take charge of this production, provide transport and to find, or, rather develop and carry on, a market for this fruit. That this and the other Fruit Companies are not British is regrettable, but all honour to those who have so well served Jamaica, and we have no wish or right to grudge them the rewards of their enterprise.

But dependence to so large an extent on this precarious crop, so liable to destruction by hurricane, is a source of special danger to the island, and particularly to the growers. However profitable, it is a lamentable position for a man to run the risk all the time of his crop for a year or more being destroyed by a storm lasting perhaps but a few moments.

Against this risk no really practicable means of insurance has yet been devised.

A proposal made a short time ago by a British Company to do such insurance was hampered by impracticable, though doubtless from their point of view, not unreasonable conditions, and it would have involved a Government guarantee for a term of years of a certain minimum total of premiums, which could only have been given by making insurance compulsory—an impossible proposition—or by saddling public revenue with liability for any deficit on the required total, which would not have been fair to the taxpayers generally.

Help from abroad in this matter being thus unlikely, it is suggested that growers might nevertheless, as wise men who have to face a contingency which is bound to materialise at intervals longer or shorter, combine in a mutual guarantee society of their own for protection against this risk.

I understand that, to be reasonably sage, the banana grower would have to calculate and provide for a possible loss of one year's crop out of every seven and that means that a premium of not less than 15 to 20 per cent. per annum on the total value of his crop would have to be paid.

This would be a very heavy deduction from this income, but it would be no real hardship to him as he, even though he does not insure, cannot escape having, on the average of years, to pay.

The difference is that he would have to bear the loss in a lump at one time, should he not make provision ahead by spreading the loss over a term of years by making annual payments.

Also, no doubt, matters might be so arranged that, the society being a mutual one, a bonus refund of a part of the profits might be made to the end of, say, seven years should a reserve fund sufficient to pay a loss of one year's crop, if incurred, have then been built up.

This would make certain that the growers would not be paying more than the necessary contribution to safeguard themselves from calamity.

I am averse to the Government assuming any liability for losses on enterprises for private advantage: but it might be justifiable in the public interest, should guarantees to pay the necessary percentage annually for a term of years be obtainable, for the Government to advance sufficient funds to provide for starting such a scheme.

Hurricane Insurance is available for coconut plantations at reasonable rates, and has been found within the last ten years of very great benefit to insurers.

Though apparently very strong, coconut trees have proved to be subject to severe destruction and loss from hurricane, which is the more distressing as a bearing coconut tree cannot be replaced in less than ten or fifteen years.

Similar insurances can also be effected on coffee crops; but as there are now very few coffee plantations in Jamaica except in the Blue Mountain district, the coffee elsewhere being mostly grown by men with small holdings, it is not largely availed of.

Financial aid till crops are marketable is probably a problem not only in Jamaica, but it is one all the same unless, as is seldom the case, producers have sufficient surplus capital to enable them to carry on without assistance until their crops can be reaped and realised.

Such aid is generally obtainable by those of good character in the shape of credit for supplies from store-keepers and dealers or from shipping firms subject to the expressed or implied agreement to deliver the produce, when ready, to be disposed of

Where amounts are important, those who make the advances very usually try to protect themselves by taking as security what is commonly known as a "crop lien," which gives the lender a first charge on the crops for a certain period—I believe the limit is eighteen months. This is all well in its way, but is often a broken reed, seeing that when the lender finds that the crops are insufficient to cover the advances, these have been already harvested and he cannot take more in the shape of crops than exists and sometimes has even to make further advances in order to complete the harvesting and preparation of what crop there is before it can be marketed.

Possibly the establishment of Loan Banks may be useful in this direction; but, if they are to succeed the Bank would have to take security on the land as well as the crop.

Owing to the special conditions arising from the great slump in sugar which made it necessary for the Government to intervene and give temporary advances, if a disastrous collapse was to be stayed off, many estates have been for more than two years, and still are, under the control of the Sugar Board.

The strength of the sugar market encourages the hope that the Government may soon be relieved of the necessity to continue the operations of this Board, which would restore to the estate owners the power to market their own produce independently. It will be interesting to see if many of them think it desirable to combine for the purpose of marketing their products.

Choice of Products.

The planter or cultivator everywhere has naturally to first consider what products can be most successfully grown with a view to making such profits as will afford a living, and in Jamaica there is a very large number from which to choose.

Apart from bananas and sugar and rum, there are coffee, cocoa, tobacco pimento, ginger, annatto, coconuts, citrus fruits, orange, oil, honey, wax, sarsaparilla, kola nuts, lime juice, sisal fibre, etc., etc Of course, the choice is severely limited by the nature of the soil and the situation of the holding— whether in a region of ample or more scanty rainfall.

Another factor which he must consider constantly is the extent of the market which will open to take his produce.

It is highly amusing at times to hear the crude opinions of visitors and new comers as to what might be done and as to the lack of industry and energy in not developing some supposed source of wealth. We are constantly told to increase production, as an infallible means of securing prosperity; but this all depends on what the product is. Jamaica ginger is known to be the finest in the world. Some years ago, puzzled by declining values, I examined statistics for a period of 12 years and found that Jamaica had actually doubled her output during that time. The result of this increase, however, was to reduce quotations by one-half.

Jamaica thus did double the work for practically the same financial return.

The truth is that the sale of products other than those of prime necessity, such as flour, sugar and such like, cannot be stimulated and largely increased by any reduction in price. In fact, more than a certain quantity cannot be sold at any price and a very small excess has an extraordinarily depressing effect.

A good housewife will certainly not buy twice as much ginger or any other spice merely because she gets it at half the price—in fact will not take more than her usual supply at any figure.

The same applies to Pimento of which Jamaica has a monopoly. As a rule, we can produce all that the world wants, but if we harvest only a small percentage more than the markets demand, a severe decline in prices teaches us our mistake.

Good judgment is a prime necessity.

It may be interesting here to note the remarkable results secured by energetic intelligence and industry in developing two products.

The first is Honey. The exportation thirty years ago was very trifling and now it has grown by the use of the best appliances and methods, stimulated by the advice and influence of the Jamaica Agricultural Society, to very large proportions, Jamaican honey being now a prime favourite in European markets.

The exported quantity in 1923 is returned at about 110,675 gallons or 691 tons of a value of, say, £17,000. This was a year of poor yield owing to drought.

The second is Orange Oil, scarcely recognized as a possible article of export till the great earthquake in Sicily opened the door to competition from Jamaica, which happened soon after our orange trade was staggered by the crushing blow of the United States tariff. Orange Oil has become a very important factor in our exports. The Customs return as exported in 1923, 154,930 lbs., value, say, about £47,000.

These two products are the more noticeable as they are necessarily worked by the smaller men and not by the larger planters.

Choice of Markets and means of reaching them—The best means of disposal of produce is a most vital problem for the agriculturist. Having determined what he will grow and by use of the most skilful methods secured the very best practicable yield, how shall he sell so as to get the utmost monetary return?

We hear much in these days of co-operation—an excellent thing in itself—but it is difficult to work this, unless there is a considerable mass of production to afford the material to make co-operation worth while, and this mass of production does not yet exist in Jamaica.

It is also difficult—in truth impossible—unless the producers have absolute confidence in each other and can be sure in their own minds that they will be fairly treated by the management who would direct the selling and divide the proceeds.

The members would also have to be content to subordinate their own judgment as to the best time and method of selling and as to prices to the management of the co-operative body.

The many local branches of the Jamaica Agricultural Society are doing good work in bringing the members together to impart and spread useful information and in some cases to make joint purchases of supplies; but co-operation in grading and selling produce does not appear likely to materialise in the near future.

An objection is often felt by producers and others here, as elsewhere, to the intervention of what are called "middle-men," as if these were mere profit-snatchers who seek payment without giving substantial service for such remuneration as they may secure but that is an unreasoning view of their activities.

The agriculturist is not himself fitted, even if he could find time or opportunity, to seek out and deal with consumers, or actual buyers abroad, and usually sells to local dealers. He is generally protected in dealing with such men by the fact that the number of dealers is excessive, with the result that competition is keen and values are commonly paid which are greater than the markets abroad justify.

These dealers in turn have to find an outlet for their purchases, and also have frequently to incur expense and use skill in completing the preparation of produce for export, grading, packing, etc; and they are well entitled to some margin of profit for such service and for the risk which they have to assume of changes in markets before they can find buyers.

At times, they re-sell in the island and occasionally they make sales direct to purchasers abroad; but more frequently they reach the ultimate buyers through Commission Houses and Brokers who furnish valuable services in selecting markets, finding and negotiating with buyers, shipping and completing the transaction besides financing the business.

The finding, selection of, and dealing with various markets, is a matter requiring special study and experience and it also calls for constant watching of conditions in different places so as to judge which outlet is the most advantageous from time to time. This is usually beyond the reach of planters and growers; and they as well as produce dealers merely consult their own interests when they utilise the services of those who devote their attention to this line of business.

The percentage charged for such work being very small, the Jamaican seller, be he the actual grower or a dealer is fully as well off as if he worked through any co-operative scheme.

Transport Problem.

This does not so much affect the producer of bananas seeing that the buyers—the large Fruit Companies—purchase on the spot and provide the shipping facilities for themselves, nor does it seriously affect the sugar growers as sugar is generally available in quantities for which steamers can easily be found; but it is a matter of great moment for those growing and handling other products.

Regular and frequent direct steamship facilities at reasonable rates of freight are vital for such perishable crops as citrus fruits, and regular means of conveyance at intervals of 3 weeks or a month, whether direct or not, at fair rates are important for other Jamaican products, such as coffee, cocoa, honey, ginger, pimento, etc., etc.

Now how do we stand? The chief difficulty in the way of such steamship service is the inability of Jamaica to provide sufficient cargo all the year round—or indeed for more than a very small portion of a

year—to make it a paying proposition unless the service is linked up with that taking cargo from other places.

Such a combined arrangement is tolerable for general cargo, but of course, would be useless for citrus fruit, unless Jamaica were made the final point of departure.

Another difficulty is that—supposing suitable steamers were available to carry citrus fruits to England—we could only find a market there for oranges in large quantities during the months of August, September, October, and November, we cannot compete with the Mediterranean, which is so much closer and has to pay so much less freight. It would also be a "tall order" to load steamers with citrus fruits only, and during those months there is comparatively little other cargo available.

It cannot be said that Jamaica is suffering at present from an insufficiency of steamers to carry the produce of the island at reasonably short intervals. The Royal Mail Steam Packet Co. have cargo steamers about every three weeks taking produce to London and some Continental ports, and they give transhipping facilities to most other important destinations. Added to this, we can reach the United Kingdom and the Continent almost weekly by means of transhipment at New York at practically the same rates as by the direct cargo steamers.

Many unthinking persons hail the idea of a subsidised line of steamers as if it would solve all difficulties, but in point of fact it would do nothing of the kind

A subsidy would only be justifiable if (1) we could not get sufficient or reasonable conveyance by any other means or (2) if freights were so excessive compared with those for similar products from competing sources of supply as to make business unworkable, this being to the general detriment.

As already stated, we suffer from no insufficiency of cargo space for Europe, and the matter of freight rates is working itself out by degrees without any subsidy. We are not yet down to pre-war rates, but are approaching them. We must remember that we had experience some years ago, of such a subsidy, one-half of which was provided by the Jamaica taxpayers and one-half by the British Government, and I maintain that it was of no service whatever to Jamaica producers save that it supplied proof of the possibility of shipping bananas to Europe if properly equipped steamers were provided, and thus gave the assurance that in case of need, we could rely on an alternative market for this fruit.

That subsidy helped us to some extent in the matter of passage rates but it gave us absolutely no reduction in freights, nor was there any shortage of freight accommodation which the subsidy served to abate.

We are now in a similar condition, having sufficient steamers to carry all we can supply, and having no prospect that any subsidy would give us any reduction in cost of transport which we could not get in the ordinary way.

It is also to be recognized that a subsidised service would only be available to one destination—with the previous subsidy it was Avonmouth, which was useless except for bananas—and would be of no benefit to trade with other markets. If the would-be shipper to the London market is to be helped by the provision of a subsidised line at the expense of the whole body of taxpayers, why should not similar aid be supplied to the shippers who want to reach Liverpool or Glasgow, not to mention those who desire to ship to Hamburg, Copenhagen, etc., etc., etc.?

The question of the benefit of a subsidy in the possible reduction in passenger fares scarcely concerns an Agricultural Conference, but it does not appear economically sound that the benefit of a reduction in rates for a very small minority, however influential that minority might be, should be gained at the expense of the great majority of the community.

It is very doubtful if the present passenger service can show any enormous profit to the shipping company. My opinion for what it may be worth, is that substantial reduction in rates would induce such an increase in the number of passengers as would give a higher profit balance. I do not especially touch on the question of a subsidy to maintain inter-colonial communication as that is not strictly a matter of interest to agriculturalists.

As a matter of business, apart from sentiment, we have to recognize that Jamaica is 800 or 900 miles distant from Barbados or Trinidad—say, three or four days' travelling distance, and we must take into account the fact that there is not any cargo trade worth mentioning between Jamaica and the other Colonies, nor is any likely to develop. The lack of passenger facilities is unfortunate for a few tourists and others, but the possible total of such traffic appears absurdly out of proportion to the subsidy which would be needed to secure such a service.

Trusting that this somewhat cursory consideration or more or less commercial lines of some of the problems affecting Agriculture in Jamaica may not have been altogether void of interest and service. I would express my pleasure at meeting so many delegates to the Conference all evidently in earnest in striving to promote the general good. (Applause.)

(*Ed. Note—A paper by Mr. E. A. Walters dealing with some difficulties of the exporter of Agricultural Produce from St. Lucia is given in Appendix "B."*)

Mr. Cousins: When I asked Mr. Gamble to contribute a paper on "Business Problems of Jamaica", I realized that he would give information of the greatest value to all producers in the Colony. If we had nothing else to be proud of it was the worthy array of expert business-men who handled our produce in Jamaica. During the strenuous times of the war when everybody was looking for food to eat, owing to the skill of our merchants in Jamaica we had such an ample supply of food in the Colony that we were able to send some of it to other more necessitous countries. In my own small way I have recently done my best in trying to get the best prices for a new production—sisal hemp—and this has given me a great insight into the expert knowledge of those who handle our produce and I realize that this is the feeling of every planter in the island. But for these experts who know how to deal with the products of the people in this country, we would not have been able to get the prices that we do obtain for our articles. A very important point raised by Mr. Gamble was in regard to pimento and ginger. We are producing more than we can get sale for.

The President: Mr. Gamble's paper has covered a wide range of subjects and I hope that when it is printed, it will be carefully studied not only in Jamaica, but in the other Islands as well. Mr. Gamble has touched upon some subjects which I have a little experience of. We have been influenced by the enthusiasm of those who come from outside with very little knowledge and say that this place

can grow anything, but when you try to find out just exactly what can be grown or what can be sold, then the difficulty comes about, and thus West Indian islands are full of a kind of enterprise based on enthusiasm and ending in financial loss. I have been constantly approached by those who want to come without knowledge—by those who want to go to the West Indies in order to acquire a little land and grow one of those things which they think these islands can grow, and we generally suggest that they come to the island and study on the spot the individual article that they want to embark in before they spend their money. Mr. Gamble has touched upon a great variety of matters which I think should be the subject of discussions in the Agricultural Societies of the Island, and I am sure that great benefit would result from such discussions, and Mr. Gamble has mentioned the question of Hurricane Insurance. Years ago I had a little to do with that system of Hurricane Insurance with regard to Cacao trees and Coconut trees. Mr. Gamble has also referred to the great difficulties that Insurance in regard to bananas presents, and he shows the way in which it might be made a workable proposition. This again is a subject which is deserving of great consideration and that is the way in which a company should protect itself. I think that the paper should be printed and commended to the consideration of every Agricultural Society throughout the West Indies. We thank Mr. Gamble very cordially for his paper and if there are no further remarks on the points brought forward by Mr. Gamble, I would now ask Mr. Brennan, the Government Meteorologist, to speak on "Pilot Balloons in Meteorology"

"PILOT BALLOONS IN METEOROLOGY"

BY

J. F. Brennan, A.M.I.C.E., F.R.M.S., Govt. Meteorologist.

I shall, with the permission of the President and members of this Conference, present a paper upon Pilot Balloons. It may be stated that although the proposal to organize a Pilot Balloon Station in Jamaica has been already taken up by the late Secretary of State for the Colonies with our Government, the Director (Dr. Simpson) of the Meterological Office, England, has expressed a desire that the matter be brought up before the Intercolonial Agricultural Conference, pointing the needs of such a Service.

It has been suggested by the Meteorological Office of the Air Ministry of England that a Station, or Stations, should be established in the West Indies, for the scientific study of the upper regions of the air, by means of pilot balloons, in order that data may be collected for the investigation of the causes of hurricanes and for other purposes, and the results of such observations shall be supplied to the British Meteorological Office, as well as to the United States Weather Bureau in connection with their system of hurricane warnings in the West Indies.

Although Jamaica is geographically situated in the track region of West Indian hurricanes, and affords an important point for observations of the Upper Strata atmospheric currents, other countries such as British Guiana and Trinidad, which are just on the outskirts of West Indian storm tracks, would contribute material aid if they also took up the work. The knowledge of the air motion surrounding the hurricane likewise, will be found invaluable.

The United States Government have Observing Stations already established at Porto Rico, Key West and the Panama Canal Zone. The last named station is not, properly speaking, at all situated in the region of frequent hurricanes, and yet appears to be giving good results.

It is almost certain that the operation of a station in Jamaica will be warmly appreciated, for the results of the observations will strengthen and further the studies in the direction of hurricane developments, and ultimately benefit the West Indian islands.

It may be noted that the work of observation must be conducted, systematically, over a period of years before the fruits of such researches can be reaped.

The laws governing the motion of the atmosphere in different strata are still in a poorly understood state, and so, by the persistent measurements, throughout each month of the year, by means of Pilot Balloons, (or, more fittingly, exploring balloons) valuable information should be eventually derived.

The undertaking of these proposed aeriological studies will not, therefore, be for mere scientific recreation, but may prove of material aid in revealing the nature of the complicated structure of the atmosphere and air movements, and so contribute to perfect, in the near future, a means of determining long before-hand, the period of birth, development and approach of disastrous storms.

It is apparent that if sound and practical knowledge could be gained in this direction it should guide the agriculturist in his movements and undertakings, as well as any Insurance Companies for crops, so that the planter's interest may be reduced from the position of precarious speculation and gambling to a sound footing.

Then again, with the great advance and promising footing of aerial navigation, any studies concerning the manipulation of air craft should be welcome and the probable benefits are self-evident.

As the occurrence of barometric depressions is at times accompanied by and much related to rainfall, a forecast of precipitation would be invaluable. The United States Weather Bureau have shown great enterprise during the past two years by securing daily reports from a large number of rainfall stations in the West Indies and surrounding places and having such forwarded to them for monthly publication. According to the last published report entitled "Climatological Data," there appeared, in detail, the record of the daily rainfall of 457 stations. In the course of time, there is every reason to anticipate these records will prove advantageous.

The following is a portion of a memorandum from the Meteorological Office of the Air Ministry, which brings out the objects and the needs of such a service very forcibly.

Upper Air Observations in Hurricane Regions.

One of the most urgent needs of meteorology to-day is fuller information concerning the circulation of the atmosphere in equatorial and tropical regions, particularly in the regions visited by hurricanes and the adjoining regions. Our knowledge of the structure of the atmosphere over these regions is extremely limited, and further observations are urgently required in order to amplify it. A more complete knowledge of the circulation of the air in low latitudes might lead to considerable advances in the accuracy with which weather forecasts could be made not only in the tropics, but also in higher latitudes. Apart from the question of our knowledge of the general circulation of the atmosphere,

it is considered that no serious advance can be made in the study of hurricanes and hurricane conditions without the upper air observations which are now being asked for.

The Director of the Meteorological Office suggested to the Rt. Hon. the Secretary of State for the Colonies that the question of hurricane conditions should be investigated by some central authority and after consultation with various other Government departments it was agreed that the Meteorological Office should undertake an investigation of hurricanes and hurricane conditions. As a first step, a memoir on "Hurricanes and Tropical Revolving Storms" was prepared in the Meteorological Office. This memoir gives an account of our present knowledge of the behaviour of hurricanes. It is now proposed that a further step should be taken in the direction of carrying out a specific investigation of the causes of tropical storms. The methods of investigation are necessarily

(a) The synoptic method; and
(b) Special investigations.

The first method demands a large network of stations carrying out regular meteorological observations. This is already being done in the West Indies by the Government of the United States of America, and to carry out similar work under the auspices of the British Government would entail considerable expenditure, and would only lead to duplication of work which is already being done efficiently.

It is considered that it would be a more effective step to initiate a special investigation of the conditions in the upper regions affected by hurricanes. These are not only the regions actually visited by the hurricanes but the regions from which the hurricanes draw energy, which may extend for great distances from the actual tracks of the hurricanes. It is considered likely that the conditions which favour the formation of hurricanes would be reflected in the wind structure of the upper atmosphere. If such a relation could be found, enabling us to forecast the genesis of hurricanes the result would be not only of considerable general scientific interest, but would also have a direct practical value in that it would give longer warning of the approach of a storm, and so diminish the material damage caused by it.

"The most obvious way of carrying out the required observations is for the colonies concerned to establish pilot balloon stations at which daily observations could be made. The work of carrying out the observations would only take up a small portion of the time of the person responsible, and the cost of equipment of the stations would be small.

"In view of the present state of our knowledge of hurricanes, it is not possible to state with any degree of detail what would be the general nature of the results which might be expected. Reference might, however, be made to a theory hinted at by a Norwegian meteorologist, V. Bjerknes, which ascribes the formation of tropical storms in the eastern portion of the North Atlantic to the slip surface between the trades and the counter-trades above them coming down to the sea surface. Such a theory would be disproved or established by means of observations of distribution of wind in the upper air. In the absence of observations of upper winds it is not possible to prove or disprove this or any other theory.

"As a beginning, it is asked that each colony concerned should equip one pilot balloon station. A list of the instruments required, and an approximate statement of their cost is given in Appendix B to this memorandum. It will be seen that the cost of equipping a station is less than £100."

In placing this request from the British Air Ministry before you, it is with the hope that it shall receive your serious consideration and support and, also, with a view to including the other West Indian colonies to assist in the matter.

Appendix A

Method of Observation.

It is suggested that in the first place, each station should put up one pilot balloon per day, the number of ascents being increased later where possible. The observations are of quite a simple nature. A small rubber balloon called a pilot balloon is filled with hydrogen until it will lift a certain weight off the ground. The filler is provided with attachable weights and a table of the weights to be attached is provided. The observer first weighs the uninflated balloon and finds from the table what weights must be attached to the filler in order to give the balloon the proper lift. The lift is arranged in such a way, that the balloon will rise 500 feet per minute.

The balloon is followed by means of a theodolite and readings of azimuth and elevation are taken at the end of each minute from the time of release of the balloon. Two observers are required, one to work the theodolite and the other to time the readings with a stop-watch, to help in taking the scale readings and to write these down. The working out of the upper winds can be done after the ascent is completed and the balloon is lost.

From the angle of elevation and the height, which is known from the assumed rate of ascent, it is easy to find the horizontal distance of the balloon at any time. This combined with the azimuth scale reading of the theodolite enables the observer to plot on a chart the position of the balloon at each minute. The drift from one minute to the next is the drift due to wind in the layer concerned, so that the wind direction and speed can be measured off the chart. The same result may be derived by using a slide rule instead of a graphical method. The computation of winds by the graphical method demands no technical skill and can be carried out by any one who can use intelligently a ruler and protractor. Charts, tables and fuller instructions will be provided for any station which may be set up. Setting up and using the theodolite is also perfectly easy for an untrained observer. The balloon is kept in the field of view of the theodolite by the rotation of two screws.

Sir Francis Watts: Considerable importance has been attached to the subject which Mr. Brennan has dealt with to-day. The British Meteorological officials are very anxious if possible to get further information, and to make a fresh effort so that the whole of the Meteorological interests on this side of the world might not be in the hands of their brethren of the United States. They are the people who are doing practically all that is done in meteorology here, and it appears to the meteorological office in London that they might rightly do something to assist in the elucidation of a problem which is of great importance to us. By the use of pilot balloons, we may learn a good deal about the origin of storms and hurricanes, and it might thus be possible to effect a considerable saving in material and life. This is the object of bringing the matter before the meeting to-day, and the aim is not only to get the support of this Government, but of the several governments, to which Mr. Brennan has referred. Its apparent annual cost is a very small sum —less than £100 a year—and the results may be extremely beneficial.

This matter is one of importance to us, and I hope the subject will be well ventilated, and that the representatives of the other colonies wil bring it to the notice of their respective governments when they return. If anyone wants to ask questions, I have no doubt that Mr Brennan will be willing to answer. If no one wishes to speak further on the subject, I will ask Mr. Barclay to be good enough to give his paper on the work and progress of the Jamaica Agricultural Society

Mr. Barclay: Mr. President and gentlemen. I take the liberty, with your permission, of altering the title of my paper slightly. Instead of calling it the Jamaica Agricultural Society, I will alter it to the History of the Jamaica Agricultural Society. Everyone in Jamaica, I suppose, knows about the Agricultural Society, and its work and progress, but few I suppose know anything of its history. Unfortunately sir, most of the men who started it, have gone. The Society I may say suffered heavily in 1923, when we lost our first Vice-President, Sir John Pringle, who had been with us from the beginning, also Mr. A. C. L Martin, who was also a Vice-President, and Mr. Adam Roxburgh, who was associated with the Society from the very beginning.

"THE HISTORY, WORK AND PROGRESS OF THE JAMAICA AGRICULTURAL SOCIETY,"

BY

J. Barclay, Secretary.

Inauguration:—

The Jamaica Agricultural Society was inaugurated under Sir Henry Blake's administration on the 7th of May, 1895. The Board of Management then consisted of a President, four Vice-Presidents, the elected Members of the Legislative Council, an equal number elected by the Members of the Society, and an equal number nominated by the Governor.

Towards the expenses of the Society, until its work was properly organized, the Legislative Council granted £1,000.

At that time, the only body dealing with agriculture was the official body named the Department of Public Gardens and Plantations under a Director—then Mr. Fawcett; there was no Agricultural Chemist, Microbiologist, Entomologist, nor Veterinary Surgeon, as at present.

The objects of the Agricultural Society, as stated at its inception, were to disseminate useful information, encouraged the improved cultivation of products, and better breeds of stock, and to watch over the interests of Agricultural Industries.

The first work engaged on was for Special Committees to make enquiry into the exact position of every industry, our markets, what could be done to improve the quality of our products, whether the number of our products could be added to, and new industries developed, and also whether we could find new markets and better means of shipping our products to any markets. Full reports were published on these subjects. It also advocated the establishment of a Stock Farm which later became an accomplishment under the Department of Agriculture. The Society played a large part in securing the subsidy for the Elder Dempster line of steamers, which secured for a period a direct line of steamers to England.

The next consideration was to reach the people with information, to inform them of the objects of the Society, show what it was doing,

what it proposed to do, and what it could do with the co-operation of the community, and generally to try and arouse an earnest interest and enthusiasm in our one and only industry—agriculture. It has proved a long and stern struggle, with many set-backs; there was a set conservatism in difference, happy-go-luckiness, casualism and know-allism (I am coining some terms for the purpose of illustration) ignorance of what was being done elsewhere, but generally a good-humoured tolerance (with some grumbles that the Society was a waste of public money)—of our operations—because of the strong belief that the Society would soon quietly expire, "unwept, unhonoured and unsung."

In 1897 the Legislative Council made a grant of £1,000 for the operations of the Society. The Agricultural Journal's first number appeared in January, 1897, and has gone on without break.

A system of Branch Societies was inaugurated, and a Travelling Instructor in Agriculture, seconded from the Department of Public Gardens and Plantations—Mr Cradwick—originally from Kew, was appointed. He is still in harness, going strong

The Society had also for a time a Travelling Instructor in modern beekeeping, the honey industry in Jamaica being most important Box hives were generally superseded by frame hives and we have now many large and small apiaries conducted on the most modern lines.

The making of Jippi-Jappa (or Panama) hats was confined to districts in the parish of St. Andrew, the plant which produces the straw to make the hats (*Carludovica Jamaicensis*)was hardly known elsewhere here. The Society distributed plants in suitable districts, held classes in hat making, and while the systematic production is still only carried on in the same old districts, numbers of girls throughout the Island make hats in their spare time which find ready local sale.

Before the Government Stock Farm was organized, the Society had imported stallions and bulls standing for service in different districts of the Island; we also gave premiums for the importation of selected native stallions and bulls; imported stock (bulls, cows, etc.) for private owners and still continue to import small stock (goats and pigs and poultry). The Government Stock Farm now can supply practically all the larger stock required

From 1907 to 1910 there were imported for private members and our Branch Societies rams of milch breeds of goats as follows:—Old English, Anglo-Swiss, Anglo-Nubians, Anglo-Toggenburg, and a pure-bred Toggenburg; but this effort has not been kept up, and the blood has, I am afraid largely been lost. The subject of the importation of milch breeds of goats and the systematic breeding of these, has been constantly before us; we have been in regular correspondence with Dr. Shannon and much has been published in the Agricultural Journal on the subject. A good deal of interest has been created in the subject. I was therefore very glad that Mr. Barnardo spoke on this subject yesterday, and that he has apparently interested the Director of Agriculture in this important subject.

In 1898 the Society strongly impressed on the Government the necessity of having an Agricultural and Analytical Chemist, and Mr. Francis Watts was appointed under joint arrangement between the Government and the Agricultural Society. He was, however, soon called away by Sir Daniel Morris to occupy a larger sphere of work under the Imperial Department of Agriculture for the West Indies. His departure has been regretted ever since.

In 1908 the Department of Public Gardens and Plantations became the Department of Agriculture, Mr. Cousins, then Island Government Chemist, being appointed Director.

In 1911 the Society made representations on the necessity of appointing a Microbiologist and Mycologist, and an Entomologist f r the Department of Agriculture Mr. Ashby was appointed as Microbiologist in 1912. It was 1916, however, before an Entomologist was appointed, after continued representations.

BRANCHES:—

Our system of Branch Societies grew, the system of Agricultural Instruction was popular; Branch Societies demanded the presence of the Travelling Instructor at their meetings and to visit the members' holdings. Two and then three part-time Instructors were engaged More and more local Agricultural Societies were formed and asked to be affiliated. More Agricultural Instructors had to be found—full time. We advertised, received usually 150 or more applications, mostly from country School Teachers interested in Agricultural development. Appointments were made, after examination by a Committee—usually three exams., oral, paper and field, and latterly the selected candidate has also had to spend one month in the office to learn details of our work.

The "Journal" became popular, articles in it were and are read, discussed and debated at meetings Reports of most Branch Meetings were and are published in full in the newspapers. Correspondence increased steadily. Here are some statistics:—

	Direct Members.	Branches.	Members.	Agri Instruc.
In 1897 we had—	364	6 with	300	1
In 1910 we had—	500	63 with	3,300	11
In 1923 we had—	571	267 with	7,621	16

I must mention, however, that there would have been even greater progress, but the Food Control period and its aftermath, which still continues, gave us a great setback. Necessarily during this period there were issues at stake which eclipsed all other considerations, and the Society was loyal to the main issues.

The issue of the Agricultural Journal is in relation to the total membership. Branch Societies pay 5/ affiliation fee per annum, and 6d. per number for the Journal, which costs at present $2\frac{3}{4}$d. each to print. Direct Members pay 4/ each, foreign members 5/- each.

The Branches hold monthly meetings as a rule, and the reports of these are sent in to the Secretary; there are too many to be published each month in the Agricultural Journal, so they appear in rotation—usually once in three months.

ANNUAL MEETINGS:—

To further show the interest in the Society, I may state that in our first years we had an Annual Meeting attended by perhaps 20 or 30 members. Later, the Office Board Room became so packed with an attendance of around 100, that we had to hire a Hall, and then the Theatre. Then the demand came for Half-Yearly General Meetings, and at these the attendance of members and delegates from Branch societies is from 160 to 180. Bear in mind, that the attendance of delegates from the further parts of the Island, especially where there is no railway, means at least three days' expenses. Delegates travelling by railway receive special passes entitling them to the return journey for single fare.

In spite of this, there is now a demand for a two days' meeting each half year!

The Governor as President of the Society usually presides at these meetings, and the delegates highly appreciate the honour and privilege of addressing the head of the administration direct.

The original composition of the Board of Management was found unwieldy and the Rules of the Society were altered so that with the exception of the Governor as President, and the Director of Agriculture as ex-officio, the Board is now entirely an elected one, each Member of the Society having one vote, and each Delegate from a Branch Society one vote. There is a triennial election.

INSTRUCTORS:—

There are now 15 Agricultural Instructors with regulated districts, and a Supervising Instructor. Their work is very important as they are required to attend the meetings of Branch Societies, make record of attendance, attendance of Authorized Persons, and subjects discussed, speak on some subject of local importance, and generally regulate local agricultural matters.

Their most important work, however, is field work, i.e., the visiting of holdings to give advice and practical demonstrations.

They take interest in local Loan Banks, and help to establish these, but are not allowed to act on local Loan Bank Committees, but may advise and help to regulate where these have not able local assistance already. Nearly all the local Loan Banks have been established through our local Societies but are kept as distinct bodies.

The work of this Institution is governed by an Instructors' Committee which meets every month Each Instructor submits a Proposed Itinerary of his work for each working day, on which must be stated the time and first place he will be at work each day, so that the Travelling Supervisor of Instructors may appear there without any previous advice and go through the day of the week with him

Immediately after the end of a month, the Instructors send in an Actual Itinerary of work done for each day, showing the number of holdings visited, number of demonstrations given, number of meetings attended, attendance, and number of Authorized Persons present to give reports on their work: they also submit a general Report under headings and also a Report on Crops. Under one heading, they report on "results of their work." These Reports are submitted to the Instructors' Committee and a copy of each is circulated thereafter to the Committee with an epitomé by the Secretary.

The Instructors are not paid a salary and official travelling expenses, but are paid from £200 to £400 according to grade to cover salary and travelling This system is simple for accounting purposes, but often means hardship, as the more work they are called upon to do the less they get to themselves. But I am glad to say that there has been an esprit de corps established and the Instructors have worked loyally and responded to all calls. For Income Tax purposes, the amount each is paid is calculated at half for salary and half for travelling. I have had to make special calls on their time and travelling after hurricanes and in severe drought periods, also for special investigation when reports are made to them of suspicious case of plant and animals diseases, etc. The result of their visits is reported to me by telegram, and if serious is immediately telephoned to the Director of Agriculture. For this special work, they have never received any compensation. During the Food Growing Campaign, they had to make very special efforts, and only

after considerable pressure were they allowed £50 each which was withdrawn when the Food Control Department was closed

We are in the position now, that unless we have several young Assistant Instructors in training, we shall not be able to replace any who retire; at present we have only money for one Assistant. The work is too important and the responsibilities too great at this exacting stage of requirements for us to turn loose any untrained men

I may say here that it has become increasingly difficult to get men of the type we aim at—men of versatile knowledge, full of vim and enthusiasm, at the remuneration offered.

COMPETITIONS:—

From results over a long period, we have found that the best means of increasing effort and production among the small cultivators, is by means of Competitions. The good results accruing from the Society's Prize Holdings Competition which takes in four parishes each year, have been most gratifying.

A vote of £300 each year is made for this. During the war years, this Competition was discontinued and a whole Island Food Growing Competition organized instead. This was very successful, resulting in a very largely increased production of food-stuffs A Champion Prize for the best effort was given by the present Governor. Governor Manning was much interested in the local Homestead Improvement Competitions and twice gave substantial contributions to these. The present Governor has also been interested and gave special prizes to local Homesteads Improvement Competitions. These Competitions proved so popular and so convincing in results that since the Prize Holdings Competition was renewed, small local Food Growing Competitions—yam, corn, cassava, principally, have been organized by Branches subscribing their own prize money with some help sometimes from neighbouring proprietors. In the Yam Growing Competitions, it is required that plantains, bananas, coffee and orange trees be planted through the yams, thus securing the establishment of permanent crops. These competitions are always carried out on old lands—some of them lately considered almost derelict, and the effects of cultivation, manure and especially bush mulching in securing good crops from such lands and through periods of protracted droughts have been wonderful.

The Society tried to secure a grant for an Island Rat Killing Competition, and we took it that this was promised, so imported the necessary rat destroyers ready to start. We did not get the grant, but nevertheless in some districts successful local Competitions have been held, with prize money raised locally. School Children Competitions have also been organized with very successful results. Keen interest is shown in these.

The Society is confirmed in the opinion that well organized Competitions, even though the prizes are small, are the best incentive to steady continued effort.

What we desire is for the Society to be able to help local Competitions by a grant equal to the amount subscribed locally up to a given total. This will encourage self-help and at the same time show that the Parent Society is interested and helping.

SHOWS:—

Before the war, there were held annually 10 Agricultural Shows of good standing, in addition to some small strictly local Shows of local products. At that time, the Society had a vote of £100 to enable us to give grants of 20 per cent of the prize money actually paid up to a total

of £10. Shows were held subject to printed regulations and before our grant was paid, a list of the prizes actually paid had to be sent to me for audit. During the war, Shows were not held, and since then we have not been able to get the vote for Shows renewed, so that the Board has not the same control The Prize Lists are, however, still submitted for revision, if necessary and the Office supplies waterproof tent covers on hire, receptacles for exhibiting agricultural products and supplies also Agricultural Instructors for judging. I, as Secretary, usually attend all Shows, and arrange for Agricultural Instructors to attend as Judges. We receive exhibits, arrange them, and judge. Usually our work at Shows is from 6 a.m. to 6 p.m.

Seeds:—

Owing to the campaign carried on in the "Journal" on the necessity of manuring and the use of legumes, there followed many enquiries as to where seeds of the various kinds of beans and peas recommended, could be got, and the specific purpose of each variety. There was also constant insistence in the Agricultural Journal on the necessity for the selection of the seed to be planted, especially seed corn. So in 1902, the Society began to stock selected seeds, there is now a large business carried on in this office, and we have always so far been in the position to meet even special and sudden demands, such as after hurricanes, and droughts and failure of crops generally, by having quantities in stock in view of emergencies. In 1902, we handed £129 value of seeds; in 1910 £780 value; in 1921 our turn-over was £6,217, but that was just after the Food Control period when a scarcity of food threatened, and we had to transfer from one district to another—from plenty to scarcity. Our ordinary turn-over to-day is around £3,000. This includes seed potatoes.

Experiences with the various legumes—Cowpeas (three varieties—Wonderful, Clay, New Era) Velvet and Bengal Beans (*Mucuna Pruriens*, Var: *Utilis*), Jerusalem Peas (*Phaseolus mungo*) Overlook Beans (also called Cut Eye, Horse Eye) -(*Canavalia Ensiformis*) sent out have been received, recorded and advice as to suitability for different districts, different conditions and different crops, sent out

During the Food Production Campaign (war period and for two years after) the Society's organization was invaluable. It enabled me within a week after the Proclamation of War, in August 1914, to send out a circular with information and advice which was read at special meetings called by 150 Branch Societies and produced instant effort and activity on organized lines

At any rate, in spite of three successive hurricanes in 1915, 1916 and 1917 (unprecedented) which destroyed on an average 10 million stems of bananas, which if we could not have exported would have supplied an abundance of food here, Jamaica was well fed. To take an instance, in 1918, we had a "Great Corn Drive." Small settlers planted 5 to 10 times more corn: large land owners who never usually grew corn came in with large acreages so that in 1919 we not only cut our average imports of 260,000 bushels per annum entirely, but had corn spoiling in storage.

Authorised Persons:—

One of the greatest drawbacks to more extensive cultivation in Jamaica especially of small crops, but applying also to bananas, especially in these days of high prices, is praedial larceny, or stealing of crops, petty, perhaps, if we considered each theft, but as thefts are repeated in the

aggregate, the value is very considerable. But there is also the annoyance, the constant nightly watch required to be kept, in many instances and the expense and difficulty of securing conviction.

In order to check this, and as an adjunct to the efforts of the Regular Police and District Constables, a system of Authorised Persons was established—that is, persons authorised to arrest thieves found in the act, or persons suspected of the theft of crops; furthermore the distinction between praedial larceny, i.e., growing crops in the field and common larceny of agricultural products, was abolished, so that the cured product, such as coffee, cocoa, etc., wherever stolen from, came under the Authorised Persons Law. They were later further empowered to stop suspected persons on the road if they had reasonable grounds of suspicion.

There are 2,100 Authorised Persons registered in our books now.

Changes in Agriculture:—

Agriculture here, as elsewhere, "wobbles", i.e., changes according to the markets Let the prices of bananas go up, and prospects seem promising for them to keep up, then other products, especially food products are neglected. Whether it is wise to neglect growing yams, to grow bananas, take the cash and buy flour and shop stuff, is always debatable and can only be judged according to the conditions of each little district.

During the cane boom, cocoa and coffee trees were cut down to make room for cane. During the high price for local foods—corn 16/ per bushel, pre-war price 4/; yams 24/ per cwt., pre-war price 8/; cocoa and coffee again suffered.

Cocoa trees and even coconuts are being cut down now to make room for bananas.

It is a precarious position for this office and the Agricultural Instructors to have to meet these problems with advice, and requires on my part, study of markets and enquiry into the position of every different district. Again, the substitution of motor cars and trucks for horses and mules, has resulted in a greater deficiency of animal manure, never enough because we do not generally house stock. How is fertility to be kept up? Only by the general use of fertilizers and legumes and rotation of crops, where this is practicable.

Department of Agriculture.

There has always been, and there is still, a good deal of confusion in many minds between the Department of Agriculture and the Agricultural Society. The former is a Government Department, with a Scientific staff—the Director of Agriculture, the Entomologist, the Microbiologist, the Chemist, and their Inspectors of Plant Diseases. There is also the staff at Hope Gardens, where nurseries are maintained and experiments are carried out. The Stock Farm at Hope, the Grove Farm in Manchester and the Lititz Plantation, are controlled by that Department. The duties of the Inspectors of Plant Diseases are different from the duties of the Agricultural Instructors. The Inspectors of Plant Diseases are charged with the eradication of Plant Diseases; their efforts have been largely confined to the control of Panama Disease of Bananas, because that is the most important plant disease to be controlled The Agricultural Inspectors on the contrary, have manifold duties. They keep a watchful eye on all Animal and Plant Diseases and Inspect Pests, report where cases come under Laws, give advice, demonstrations in treatment, and help provide means for control or eradication for those who do not know of or cannot

readily get the means for dealing with pests and diseases. By means I do not mean money, but medicines, Insecticides, antidotes, etc. Each Instructor is provided with materials for carrying through this work.

The Instructors form the connecting link between the Board, the Office and Agriculturists. It is a mistake to think that their operations are entirely confined to small settlers; they are also called upon by large proprietors especially in connection with the control of Plant Diseases and Insect Pests, and in opening up new industries to districts

Politics and Agriculture.

There is one steadfast rule of the Society which has been regularly adhered to and that is—no politics. Nothing even verging on political matters may be discussed at our meetings; it has been a hard rule to adhere to strictly, but we have done it successfully Local Citizens' Associations have been established, which can discuss politics to their heart's content; we concentrate on Agriculture in all its branches; railway rates, shipping, roads, taxes, duties, all come within our purview, but not criticism of Imperial or local politicians, nor can there be any organized effort in our Society to nominate or even support candidates for the local Legislature. At any rate not in our meetings or through our organization.

Comparative Statement—Imports.

Bacon, 1909-1913, 49,179 lbs ; 1917-1921, 54,139 lbs.; 1922 (Year of severe drought), 115,262 lbs. Remarks—No local production.

Butter, etc., 1909-1913, 1,105,337lbs.; 1917-1921, 476,846 lbs.; 1922, 727,610 lbs. Remarks—A substantial local industry has been created.

Bread and Biscuits, 1909-1913, 3,574,328 lbs.; 1917-1921, 81 904 lbs.; 1922, 77,601 lbs. Remarks—Result of local biscuit (cracker) factory

Flour, 1909-1913, 262,037 brls.; 1917-1921, 230,165 brls.; 1922, 251,-987 brls.

Corn, 1909-1913, 260,187 bushs; 1917-1921, 52,124 bushs.; 1922, 175,-114 bushs. Remarks—To some extent result of substitution of motor vehicles for animal power.

1913, 260.164; 1917, 70,768; 1918, 15,832; 1919, 6; 1920 65,207; 1921, 108,807; 1922, 175,114.

Cornmeal, 1909-1913,58,540 brls; 1917-1921, 41,843 brls.; 1922, 37,-186 brls.

Rice,1909-1913, 14,218,260 lbs.; 1917-1921, 13,901,920 lbs.; 1922, 19,880,041 lbs. 1921,14,091,705 lbs.

Peas and Beans, 1909-1913, 17,533 bushs ; 1917-1921, 3,754 bushs.; 1922, 5,371 bushs.

Milk, 1909-1913, 55,083 cases; 1917-1921, 32,573 cases; 1922, 80,933 cases. Remarks—Drought reduced supply of milk in 1922.

Dried Fish, 1909-1913, 11,289,241 lbs.; 1917-1921, 6,697,891 lbs. 1922, 13,807,419 lbs. Remarks—Salt Fish is the most economical form of animal food and when times are hard it us used in preference to fresh beef, etc

Salt Beef, 1909-1913, 4 882 brls.; 1917-1921 1,853 brls.; 1922, 4,885 brls.

Pork, 1909-1913, 5,304 brls.; 1917-1921, 3,304 brls.; 1922, 5,097 brls.

Sir Francis Watts: It is of very great importance, I think, to have the record which Mr. Barclay has put before us, of the long life and activities of the Jamaica Agricultural Society, a Society which I believe is unique in its character in this part of the world. There is nothing exactly like it anywhere else. It is evident it has done an immense amount of useful work and improved public conditions in Jamaica in an extremely signal manner. The Jamaica Agricultural Society, I might explain means the writer and reader of the paper we have just heard (applause). He is the institution, as I can personally testify, because, as I told you, I was at one time directly associated with that establishment. It will be extremely useful to have this history written and recorded in the way it has been done by Mr. Barclay There is one illustration of the value of the establishment of the Society which he has given, and which is significant. That refers to the manner in which it was able to increase the food supply during the war.

You have there an organization ready at hand at a time when things might have been extremely difficult, when disaster might have overtaken the island for want of food. But with this organization already in force, ready to give practical and efficient assistance, a large amount of food was grown, brought to market, and distributed, and there was no famine. That was only one instance of the extreme value of the society to this colony. In other directions, wherever the efforts of the small cultivators are in evidence, there the Jamaica Agricultural Society makes itself felt. but as Mr. Barclay said, it is not only in relation to the small settler that the activities of the Society are devoted, but in connection with the larger planters too (applause), though it is quite evident that its main activities attach themselves to the small settlers with whom it comes into immediate contact, through the Central Association and the Branch Societies, which is incorporated with it. It is a unique society, and I say it is doing unique work. It is extremely valuable to the community and it reflects good credit on Mr. Barclay and his able assistants (hear, hear). The Society is so well known to all of you here, and if anyone wishes to ask Mr. Barclay any questions, or to say anything more in relation to it, then I wish to state that there is ample time for short remarks on the subject. If anyone wishes to speak on the subject of the Jamaica Agricultural Society, there is time enough to do so.

There was no discussion.

Sir Francis Watts: Before going further,—I am about to call on Mr. Nash for his paper before Mr. Nash reads his paper, which will conclude the programme that was set before us—I may state we have almost gone through our agenda, and after Mr. Nash's paper. I propose to close the conference before lunch time so that there will be no necessity for us to meet this afternoon unless something arises Immediately after the reading of Mr. Nash's paper I propose to conclude with the usual formalities

"A STATE OF AGRICULTURAL BANK FOR JAMAICA."

BY

THE HON. A. G. NASH, B.Sc.

"Agriculture not only gives Riches to a Nation, but the only Riches she can call her own."—Dr. JOHNSON.

As the most vital department of human activity, Agriculture occupies a puissant place in the promotion and development of the Commerce and Manufactures of the World, and also in solving or ameliorating the Social, economic and political problems of any Country.

For no other nation therefore can the fundamental industry of the landworker have a more important bearing on national life and int rests, than that Empire whose realm embraces in its boundaries and its polity nearly a quarter of the land surface of the globe and a commensurate portion of its population.

The diversified character of the peoples that compose this vast Imperial family of over four hundred and twenty millions, of every conceivable clime, and living under the most di-similar conditions of physical and geographical environment, offers of itself a rich and attractive field of study to the ethnologist and to the inquirer into inter-racial problems, but accompanying this picturesque aspect of British dominion is the stupendous responsibility imposed on British Statesmen and Administrators of promoting and protecting the interests and happiness of this vast and scattered multitude, and of directing its industrial energies into those channels of enterprise best suited to local character and conditions.

Authorities on Commerical and Economic Geography and Political Economy concur in the opinion that no Empire is better adapted, and should be more capable of sound commerical and economic expansion for the common betterment of its subjects, than that great Commonwealth of nations comprised in the designation of Great and Greater Britain.

Its territorial magnitude and variety of resources, the complementary character of the productions of its temperate, sub-tropical and tropical regions, respectively, seem to offer an almost unlimited sphere for reciprocal trade and for the attainment of that great ideal of Imperial solidarity enunciated by the late Right Honourable Joseph Chamberlain.

That great Statesman realized that the bond of Empire could only attain its full force and efficiency when it was reinforced by stronger ties of personal and material interest, than existed in the past between the Mother Country and he Colonies, and by a policy which would regard the prosperity and happiness of all as identical. Equally important with knowledge of the potential assets and active industries of any Colony, is a careful consideration of the methods and Agencies best adapted to exploit or expand its resources, and it is here that the human factor in native predilections, in native aspirations and even in native history has often an all-important bearing not only on determining the progress and independence of a Colonial community, but concurrently in contributing to the Empire's wealth and the Empire's safety.

Overshadowed by he wealth and importance of those Great Colonies which have assumed the title of Dominions and aspired to full partnership with the Mother Country, and by the Great Empire of India, the West Indian Islands suffered an eclipse by these great imperial luminaries and are just emerging into light and attracting once more the interests of the national conscience and assuming their legitimate setting in the jewels of the Imperial Crown.

The regeneration of these Islands and their continued progress is almost entirely dependent on improving and increasing the economic development of the land, and having confidence in its responsive vitality and promise as a permanent source from which the Empire's trade will

be strengthened by the production of those commodities best adapted to the natural attributes of soil, climate and population.

The defects and deficiencies of the existing conditions are apparent. In the first place, the lack of efficient ocean transport facilities conducted on Imperial lines and for Imperial gain not only imposes a restraint on the expansion of trade and reproductive industry, but actually deflects to foreign lands much that could be sold in the Empire's marts to the mutual advantage of producer and consumer.

The present difficulties with which our oversea intercourse has to contend will, if not remedied in a short time, prove fatal to British interests and commercial prestige in these Seas.

In Jamaica and apparently in most or all of the sister Colonies, the lack of financial aid to the primary producer of the Island's wealth, the Agriculturist of all classes, but especially the middle and small settler, has seriously retarded its economic output and advancement, and without doubt acted adversely on the Social and industrial habits of the people.

The duty of every Government is to encourage by Legislation and, if needed, by prudent and well secured credit the industries from which the national wealth and Revenues are derived, which in our case is the basic industry of Agriculture, and it needs no special faculty of observation to appreciate the fact that this Island cannot make real and permanent progress in material wealth and happiness, until a clearer and closer relationship between well regulated credit and Agriculture is recognized, and some practical means devised to help the honest and enterprising man with the necessary credit to extend or improve his cultivation or agrarian pursuits, and as a result not only add to his comfort and power of purchase but strengthen the financial position and consideration of the Colony, and contribute his fair quota to the self-supporting aims of the Empire.

That some State aid was needed to stimulate agrarian effort was recognized in 1912, during the administration of Sir Sydney Olivier when a law was passed creating the present Agricultural Loan Societies Board to control and superintend those Co-operative Loan Banks that were assisted in any way from the advances authorized for that purpose by the Legislature of the Colony.

Our people have often been reproached with a deficiency of co-operative instinct or capacity, and of being slow in initiative and in industrial and economic enterprises, but while these defects of national character are evident, they are not innate as is proved by the creation and successful operation of many Loan Banks and Land Settlement Schemes in different parts of the Island on the one hand, and the increasing interest and receptiveness displayed by the settler in the value of improved methods of husbandry, and in the practical demonstrations of the Instructors and missionaries of the Jamaica Agricultural Society on the other.

It has not been so much want of capacity and intelligence that has retarded the economic and intellectual progress of the Colony, as the lack of opportunity in technical training, in industrial and moral precept and example, and in well directed capital to stimulate and enlarge its indigenous industries. Bestow these advantages, and there will be supplied the chief ingredients for the founding amongst a large number of our people of a spirit of sound citizenship of which any Empire might well be proud.

Lord Bacon has remarked that if you would work any man, you must either know his nature and fashions and so lead him, or his ends and

so win him, or his weaknesses or disadvantages and so cure him or those that have interest in him, and so govern him.

Before one can utilize human effort to the best effect, it is necessary to comprehend not only the nature of the machine in which that energy is encased, but be capable of extracting its full competence of efficiency with the least friction and consumption of fuel.

In every land, man and his physical and organic setting as well as his ancestry and early training are correlated facts. The West Indian like other nationalities has his peculiar traits, and it is only by a sympathetic study of his character, his history, his needs and pursuits, and by the doctrine of human brotherhood that the best results in individual and collective advancement can be encouraged and elicited.

We have but to revert to circumstances in connection with the experiences and obligation of the earlier generations of this Colony to identify and connect the cause with the effect in the partiality for association or companionship in field work which has survived and in his somewhat slow appreciation of the great advantages to be derived from well organised co operation or Communal action.—While the discipline and practice of Estate life was conducted in gangs, anything like combined action outside that sphere was strictly interdicted as a political and social heresy, and any infraction of this unwritten ordinance was visited with the most severe consequences as dangerous to the safety of the Colony.

The Jamaican is learning in his own way and in his own time, the value of co-operative association, as evidenced by the Loan Bank movement of 1912, and it is safe to say that if rightly directed and expanded, and supplimented by the establishemnt of an Agricultural Bank in which all State assistance and rural credit will be focussed, the resultant effect must prove beneficial in improving the social and economic status of the Island, and influence its future histo y as a part of the Empire. A strong attachment to his native land is a common attribute of the West Indian, and in the Jamaican is fortified by an innate predilection and ambition to possess his own freehold. It is therefore largely on these national characteristics that the commercial regeneration of the Colony must depend. They constitute the chief foundation of patriotic sensibility upon which could be reared, if the right policy were pursued, an edifice of enduring progress for the Colony.

Loyalty and patriotic sentiment, however profound and valuable, cannot of themselves solve the industrial, social and economic problems of a country, without that element of material prosperity which Mr. Chamberlain warned the Dominion Premiers some years ago as absolutely essential to both Colonial and Imperial interests, and as the key to the commercial and economic consolidation of the Empire.

We in Jamaica have been contending, not as a favour but as a right, for a greater concession of Imperial preference, and for a commercial policy more in accordance with that practical Imperialism which has been so loudly proclaimed as the future commerical regime of the Empire. We also feel that, as those most interested in the success or failure of our system of domestic economy, we should have a larger say in deciding questions of such vital importance as the utilising of our own savings and guaranteeing our own loans for the purpose of stimulating rural and pastoral industries and increasing the exports of the Colony.

Sir Sydney Olivier's rule was signalized by the opening of the first State—aided Loan Bank, and to his keen habits of observation, his active and unwearied movements amongst the people he governed, and to his wonderful grasp and analysis of native character, must

justly be ascribed the final recognition by the Government of the Colony of the expediency and wisdom of some form of easy credit based on legal sanction, to duly constituted Agricultural Associations.

He displayed also commensurate talent in the selection of his agents for the propagation of the Gospel of co-operation amongst the yeomanry of the Island. Prominent among those employed for this special service was the late Mr. J. T. Palache, an Instructor of the Agricultural Society, who in addition to his firm belief in the virtue of communal enterprise, possessed all the enthusiasm of a truer lover of Nature, and an extensive knowledge and experience of tropical agriculture and stock farming. It was thus that the first systematic attempt under direct Government auspices to prepare and sow the field of the new economic doctrine was conducted and the start given for the application of the provisions of Law 6 of 1912.

The presiding genius of the Loan Board, created by the same Law, was the Island Treasurer, the late Mr. C. C. Anderson, whose financial ability, optimism tempered with caution, and well assured insight into local character and conditions, made him eminently fitted for such a position. In addition he had reorganized the Savings Bank and established it on a foundation of confidence and equity unknown in the Colony. His capable management of this Institution, so closely connected with national thrift, and his devotion to the public interests of the Colony will ensure an enduring place for his memory, while his efficient direction of the Agricultural Loan Board established a landmark in the history of Rural Legislation and Co-operation in the Colony.

At present there are 35 Loan Banks under the general control and superintendence of the Loan Board appointed in 1912, and these on compliance with the Regulations passed and approved by the Governor in Privy Council have since their inauguration at different periods, been accommodated with loans from the special appropriations made by Resolution of the Legislative Council from time to time, amounting in the aggregate to £114,005 16s. 4d. to the end of October, 1923, of which £90,375 3s. 4d. was repaid and £23,630 13s. 0d. wa outstanding at the same date. They represent at the corresponding period a total issued Share Capital of £55,444, a collected share capital of £35,528 17s. 8d. and a Reserve fund of £17,544 18s. 8d. The combined membership of these 35 Banks was 9,406 and the number of of Shares issued and paid up 12,200 and 5,528, respectively, on the 31st October, 1923.

It is both important and instructive to note that the circumstances under which a large proportion of the total loans made between 1912 and 1917, inclusive, by the Government were phenomenal. A drought of almost unprecedented protraction and extent in 1912, was followed by an unusual succession of destructive hurricanes, commencing the same year, and prompt action was imperative to meet the troubles and distress arising from these calamities, to assist the sufferers, especially in the Banana districts, to re-establish the industry on which their individual welfare depended, and which had grown to be of paramount importance to the export trade of the colony.

The loans for the resuscitation of the devastated areas partook of the character of a mixed philanthropic and economic venture, and really had no connection with the legitimate functions of the original Statute Law 6 of 1912 until subsequent special legislation, by supplementary Laws was effected, placing such appropriations under the control of the Agricultural Loan Board.

That the credit was justified is proved by the fact that nearly the whole of the large sums allocated to the Loan Banks for meeting these emergencies have been repaid, and the direct loan of £44,680 to individuals has been completely liquidated. The Inspecting Officer of the Loan Board in a report submitted to the Board at the end of the Financial year 1921-22, says, "Bearing in mind the absence of all knowledge of finance and accounting and of any past experience of co-operative effort by the members of the committees of the Loan Banks, I am of opinion that the recovery of £47,000, of the £48,821 of the first loan to meet the unfortunate times arising out of successive hurricanes, droughts, and war conditions is an achievement of which the Board and the Banks may well be proud."'

As cognate to a consideration of the adverse economic conditions arising from the natural catastrophes just reviewed, we have to add the unusual financial strain created and prolonged by the war, and the fact that ten thousand of our ablest manhood had been drafted for service in the gr at conflict, and chiefly from the Agricultural industries of the Colony.

Associated with operations of the Co-operative Loan Banks, and in some cases under the direction of the Lands Department a recent scheme of land settlement was started in 1920 whereby a Loan Bank is enabled to purchase a property for re-sale to small settlers, or in the event of a genuine demand being made by a community for land for agricultural colonization, the Government may under Law 49 of 1920 acquire the necessary land at the expense of the Colony for the purpose of selling such property for the purpose of Agricultural holdings, such acquisition being deemed a public undertaking under the Public Land Acquisition Law 1897.

This great scheme of land reform has been promoted and fostered by our present Governor, Sir Leslie Probyn, and is destined to have a far-reaching effect in the solution of many of the prevailing social, industrial, and economic problems of Jamaica

Under the Land Settlement Scheme £52,974 has been loaned to the Co-operative Banks under Government supervision, of which some £15,000 as well as interest has been repaid. Investments of the same nature to the amount of nearly £10,000 are being dealt with directly by the Surveyor General.

The acreage acquired under the former head is about 8,171 while the total land acquired by Loan Banks and other agencies is collectively about 13,000 acres.

It is interesting to draw attention to the enhanced assessed Revenue value of property which has been transferred from individual to communal ownership, and two instances will suffice to show the advantage to the State and to the community of a sound land policy for the Island. Two properties forming a part of the operations of the Western St. Mary Loan Bank originally assessed at £5,435 and £4,047 now contribute to General Revenue on a basis of £10,000 each, while the properties that have fallen into the hands of this progressive and enterprising Association have undergone a surprising economic transformation.

It is the duty of the Government to know its country in more ways than one, to know the genius of its people, the possibilities of its soil and other natural capacities and then to co-ordinate those factors to the activities for which the native mind has a natural bent. Indeed to look upon the development of that country in the light of a National Policy.

In this Island we have only touched the fringe of economic evolution, and the principle encouraging the undisturbed possession to every enterprising and honest citizen of a sufficiency of land for establishing a home and a permanent industrial calling can only be promoted and accelerated by utilizing the savings of the people in furtherance of the people's independence under a system of State guidance. The development of the country by judiciously loaned capital would also tend to check these monopolies which in time must otherwise inevitably strangle the free enterprise of individual settlers.

While we are standing still or only slowly realizing and adapting ourselves to the altered economic and commercial conditions of the world, disregarding the competitive designs of other countries, and the new Imperial position, our neighbouring Islands of the Greater Antilles possessing no pronounced advantages over us, except well directed energy and capital, are forging ahead, and in the case of Cuba actually drawing upon our best resources of man power, while our own fertile land is neglected for want of some organized system of rural credit such as State Agricultural Bank would afford and which would give the native an opportunity of devoting his energy to the reproductive industry of multiplying the crops of his own land, of living under his own "fig tree" and under the same flag that he has been nurtured, and reverences as emblem of true freedom.

During the decade ending 31st December, 1922, the emigration to Cuba of our labouring classes amounted to 75,328 persons and the arrivals at 56,311 during the same period, showing a deficiency in returns of 19,017 or 25% of the emigration. It is safe to say that as the Jamaican communities increase in Cuba, and as our people acquire the language, and indentify themselves with the habits and customs of Cuban life this percentage of returns will gradually lessen, and most of our able bodied labourers, and a good many of our most virile and intelligent citizens will be permanently lost to the Colony and to the Empire, while our own rural life and national sentiment will suffer as well as its industrial and civic efficiency.

The practical world requires the fact that one's home is not so much where you are born as where you are happy and prosperous, and as an eminent writer has said the business of every Government should be directed towards strengthening "the grip of the land on its inhabitants as a thing of nature, and as the great source and safeguard of patriotic feeling."

The initial motive of the Jamaica's exodus to Cuba is indicative of this feeling. His adventure abroad is not the natural effect of over-population or of a desire to escape from the drudgery of agricultural field labour, for the population of the Colony as ascertained by the last census in 1921 was only 193 per square mile or 7 more per square mile than in 1911, and the average area per head inclusive of the urban and suburban communities of Kingston, St. Andrew and Port Royal 3½ acres, while exclusive of these townships the comparative relation would be about 4 acres per head of the population. His occupation in the neighbouring Island is that of a plantation labourer, in Jamaica what is termed a cultivator, and therefore some other cause than a mere spirit of restless enterprise must be sought for the reasons which prompt him to leave his own home and fertile soil to seek similar work under more exacting conditions and under a foreign flag.

We have not manufacturing industries nor mining attractions and his sole outlet and prospect of obtaining a future independence lies in the pursuit of his familiar and traditional calling of tilling the soil.—

If his standard of living is to be raised, if his power of exchange and purchase for the commodities and merchandise of other parts of the Empire is to be enhanced, we must do what all the Canadian and Australian Provinces and almost every advanced country in the world are doing, develop rural life and industry as a National business and as our supreme asset to meet our domestic and Imperial obligations, and to ensure our own comfort and happiness.

The intention and natural desire of the average Jamaican labourer who goes to Cuba is to gain sufficient money to purchase a few acres of land, to construct a home and in a few years ultimately to return o his native land to continue his rural occupations as a small landowner.—This is sometimes accomplished, but generally by years of toil and the passing of the best of his career abroad.—It is affected sometimes by instalments of a few seasons or years abroad, then a temporary visit home to invest what he may have saved, and subsequent emigrations and returns to complete his original aim. The disadvantages however are that in a vast number of cases, cultivations at home are abandoned or deteriorate, the best physical samples voluntarily expatriate themselves during the most valuable period of their lives, while the weak, old and incapable remain to increase the burdens of the State in poor relief and the progress of p oduction is retarded to the prejudice of national agriculture.

It is true that considerable sums have been sent home from time to time by those who go abroad and have proved welcome and useful to many dependents who have been left behind, but if this volume of capable and intelligent energy is so valuable to the agriculture of our neighbouring Island, why not to Jamaica which is producing it, and why should this Island be deprived of its useful activity in building up our own welfare and capitalizing our own opportunities, if we can find a remedy for this economic mistake?

We deliberately supply sinews of labour, the chief counterpart of Capital, to a foreign and rival industry, and deplore our own slow progress which could be averted by the adoption of a rational policy of domestic encouragement which would give impetus to our own reproductive industry of the same type.

The land, which if properly treated is always grateful, and in which all the present and future prospects of this Island are centred, should in accordance with an ancient Chinese aphorism "be the great borrower of the nation," and a prudent, enlightened and comprehensive system of credit to rural enterprise and workers should be established as soon as possible. The destiny of the Colony politically and economically ultimately depends upon a full realization and application of this fact. Such a policy would profoundly influence emigration, encourage enterprise and thrift and be one of the chief means of building up a sense of sound and responsible citizenship amongst our people.

In a report which was transmitted to His Excellency the Governor by an influential Committee of Planters in the Colony, pointing out amongst other desirable reform the necessity for State action in the development of Agricultural Industries, a comparison was made between the value of exports from the Islands of Cuba, Trinidad and Jamaica, represented as over £17 and £11 per head for the first named Islands and only £3 per head for Jamaica. In the year 1921, the exports of the Colony gave a per capita return of £3 18s. 3d. In connection with this output, the reduced purchasing power of the Pound sterling has to be taken into account.

The report refers also to remarks:—"There can be no doubt that if Jamaica is to make progress a safe constructive policy suitable to our local conditions is imperative and it is surely the part of sound statesmanship to devise a remedy which will enable us to utilize our own labour and capital in developing our resources on lines which will give stability to our economic conditions."

There are about 150,000 small holdings in the Island and according to the last census there were 286,000 persons engaged in Agriculture. This army of agrarian workers needs, however, the ammunition and machinery of Capital and improved scientific methods to impart full propelling efficiency to its energies.

The exports of the Island should be quadrupled and the requirements of local domestic life be fully satisfied as well, but this can only be accomplished by a campaign of economic development founded on reasonable and quick ocean transport, by a consistent Policy of Imperial preference, and upon an adequate portion of our own savings being invested for the purpose of extending the areas of cultivation to create new wealth, and promote a more useful and happy existence for the masses of the people.

The physical conformation of the Island, its geographical position and geological structure as well as the character and history of the people who compose the overwhelming majority of its inhabitants, combine to determine Agriculture as the only calling upon which the Colony can rest with confidence.

It is computed that between three and four million pounds are deposited in the four Commercial Banks that are operating in this Island, and it is only natural that most of this money would find its way to the countries of their origin for investment. The policy and constitution of these Banks could never embrace the sphere of financial help which the creation of a State Agricultural Bank is intended to cover, nor could there be any correlation of these trading Banks with the Co-operative Loan Societies which it is proposed should be financed by a State Agricultural Bank. The nature and period of loans such as would meet the requirements of the client of an Agricultural Bank would be quite different, and especially so in this Colony, and it would not only be desirable but expedient to utilize as much as possible the established and increasing influence of the Agricultural Society and its Instructing Officers in the occasional inspection or supervision of the cultivations and improvements, or to report on the purposes for which loans were assigned or to which they were devoted.

Hundreds and in time thousands of honest and energetic small settlers who appreciate the advantages to be derived from improved methods of tillage, and also the practical value of the instruction and demonstration imparted by Agricultural Instructors but who are now barred from financial help, except at ruinous interest, and by prohibitive conditions of time and repayment, would be willing to give ample security, not only in property but in character, for assistance to tide them over temporary difficulties, pending the reaping of marketable crops, to extend the scale of their operations and to improve their holdings.

By general assent, it is recognised that the Agricultural Society of this Island is, by means of its different channels of knowledge and information, sowing the seeds of a radical change in thought and accomplishment amongst the rural population and creating amongst them an emulative and progressive spirit unknown before in the Colony.

The external trade of Porto Rico, an Island about the size of Jamaica, was quadrupled in the first decade of American sovereignty, and valued

at about £16,000,000 in 1914, leaving at that time only about twelve other countries in the world exceeding its purchases from American manufacturers. There, the expansion of internal trade has kept pace with the growth of external commerce. In seven years, the increase of taxable value was nearly 100%. The exportation of sugar increased five-fold and of cigars fourteen-fold in 10 years, while the population increased from 800,000 in 1898 to 1,200,000 in 1912.

The same source of information of these facts, referring to Jamaica, remarks "With its splendid diversity of climate brought about by the wide range of elevated land, many of the fruits of the temperate zone may be grown, as well as those of the tropics, and Jamaica may become the orchard of Great Britain."

There is no doubt there is a gradual awakening taking place amongst the people of the Island to the value of their inheritance and what is being acheived in Porto Rico could certainly be accomplished here, in an Island rich in natural possibilities, and rich in Imperial loyalty. A permanent source of prosperity could be established by a wise policy of helping the land to multiply its yield in response to the improved arts of man.

The horizontal projection of the land is estimated at 4,450¼ square miles, or 2,848,160 acres, but the actual superficies must on account of its mountainous character be greatly in excess of that area. About 413,440 acres may be called flat, and about half the area lies above the 1,000 feet zone of elevation.

Two of the great needs of the Colony related to agricultural, economic and fiscal ends is an up-to-date map, based on trigonometrical and orographical surveys, and co-ordinated with revised geological data; and the regulation and encouragement of re-afforestation.

The area under cultivation as given by the last statistics is about .35 of an acre per head of population, or including grazing land 1.4 acres.

During the period 1912 to 1921 inclusive the total value of the exports of the Colony amounted to £27,595,059, all originating from the industry of agriculture, while during the same decade, and for the first time in our history, only 54 per cent. was invested by the State to advance the interests and improve the position of those who are the only creators of the Island's wealth.

Amongst the suggestion made for meeting the exigencies of increased rural production and to encourage the people to settle on and develop the soil of their native land, is the establishment of an Advance Department of the Savings Bank.

At present practically two-thirds of the people's Savings deposited in the Government Savings Bank are invested in securities in distant part of the Empire, but strange to say, not one penny of the £343,000 so invested has found its way into the loans effected by our Sister Islands in the Caribbean Sea or on the Mainland, although some like Trinidad and Demerara are almost immune from those natural catastrophies to which we are susceptible, and their credit quite as stable as ours. Mutual credit, would create mutual interest, and tend as much as any other factor to draw the Island and other Colonies together for ultimate commercial and probably political federation.

The proposal was that Jamaica should follow the example of the Australian Provinces modified in some respects to suit local conditions, and that the Deposit Department of the Savings Bank should invest the bulk of its deposits in the debentures of the Advance Department which would make advances to landowners on approved mortgage

securities, and to the Co-operative Loan Banks, and that the methods of the Savings Bank should be revised to meet its new functions.

The Savings Bank deposits are guaranteed by the General Revenue of the Colony, and in regard to their appropriation in the manner suggested, the late Mr. C. C. Anderson, the Island Treasurer and Manager of the Bank, in a letter to the Agricultural Society dated 24th September, 1919 wrote:—

"If your Society will co-operate with the Bank Board and assist in making the Bank a success on the lines of the Queensland Government Bank, it will not be necessary for patterns to be taken from Holland, Denmark or Germany.....I feel sure that if this Board obtains the co-operation of your Society in their endeavour to make the Bank a factor of progress it will succeed in the same manner as the Australian State Banks have done"

The Hon. E. L. F. Wood in his Report, and under the head of Agricultural Banks, while adverse to the using of Savings Bank deposits as capital for a State Agricultural Bank says "In many of the Colonies, however, I understood that if a reasonable scheme could be framed involving only the provision of local capital, the Colonial Office would deal with it in no pedantic manner, but would give whatever assistance might lie within their power".

After all, it is the application of our money to what may be deemed our own urgent needs that we are pressing for, and better and comprehensive credit facilities to be given to the dominant industry of the Colony, and we feel that with our intimate knowledge of our people, and in such a purely domestic question as the establishment of a State Agricultural Bank we would have a deciding voice. No persons can be more interested than ourselves in our national progress, and just as our Director of Agriculture commented a few days ago, on the capacity and fine spirit of industry and enterprise which had characterized our people in connection with the development of the Banana Industry, we feel that we are capable and patriotic enough to undertake a responsibility in which our own general interests will be affected for the better.

The alternative schemes to these of an Advance Department of the Savings Bank have been presented to the Government in a recent report of a Committee of the Agricultural Society.

The authorized Capital of the proposed Bank was recommended to be £500,000, to be raised by Debentures and Preference and Ordinary Shares in certain proportions, and to be guaranteed by the Government, or that the Government should take half of the different classes of investment. Either of these arrangements would create public confidence and give the Government a strong interest in the Management.

The building up of a strong Reserve should be a salient object of the Bank, and as a consequence tend to lessen the responsibility of the Government as time went on.

It is generally felt that we have arrived at a stage when it is most necessary that we should have a permanent Institution to deal with rural credit on a scale suited to the conditions of the Island, and operating in terms to suit all classes of landowners but with special consideration to that numerous body of proprietors whose individual scale of operations are comparatively small, but whose collective enterprise is of vast importance to the exports and general prosperity of the Colony.

The establishment of a State Agricultural Bank, should be acompanied with a strengthening of the Agricultural Society, in the way of increased grants and an extension of its functions so as to utilize to the fullest extent those educative and personal influences and that constant Supervision for which there is a growing regard in the minds of our people.

A new feature in land settlement projects has recently been introduced into the operations of the Western St. Mary People's Co-operative Loan Banks, whereby loans for the building of cottages of approved type or for the improvement of existing ones may be obtained on "easy" terms of repayment. I understand that this excellent example in housing reform will be followed by some other Land Settlement Corporations in the near future

In closing this paper the most appropriate symbol of our Imperial Connection I can think of is conveyed in the device and legend which were impressed on the Seal of this City of Kingston when it had the distinction, I think, of being the only city in the West Indies which enjoyed full Corporate privileges, and which we trust are still emblematic of our Great Mother's policy, as we are sure of these natural blessings of Providence we enjoy, representing Britannia holding a trident in one hand and in the other a mirror reflecting the benign rays of Heaven on the produce of the Island—in the distance a ship under sail, and the Legend "Hos fovet, hos curat, servatque Britannia Mater"—Britannia the Mother fosters, cherishes, and protect these fruits.

Sir Francis Watts: Mr. Nash has given us a full account of the needs which are felt in this island of an agricultural character, and how they may be met. He has also circulated during the reading of his paper an interesting map showing the areas which are occupied by the various agricultural industries, and by indication, shown how much they might be extended by areas not covered. I do not know if anyone wishes to ask Mr. Nash for any further details of the large schemes he has proposed, or whether he has sufficiently elucidated what he wishes to put before us. If no one wishes to speak on the subject I will ask Mr. Bovell to move a resolution.

Mr. Bovell: On behalf of the visiting delegates from the Old Country, and from the other West Indian Colonies, it is with much pleasure I beg to propose a hearty vote of thanks to the Government of Jamaica, and to the inhabitants generally, for the great help and assistance they have given, in rendering the Conference the success it has been, and for the courtesy with which the visiting delegates have been treated during their stay in the island. In this connection, I would like to mention the names of the Honorary Secretaries, Messrs. C. C. Gowdey and C. G. Hansford, who have been indefatigable in smoothing away any difficulties that may have arisen (applause).

Professor Ballou: I have great pleasure in seconding most heartily the vote of thanks proposed by Mr. Bovell. We have all seen—I think everybody realizes the amount of work and organization and attention to detail that is necessary to make a meeting of this sort a success, and avoid confusion. And I think the work that has been undertaken by the Jamaica Government and the way that work has been carried out by the Secretaries delegated to look after this conference, has been most perfectly well done. I support heartily the motion before the meeting.

Sir Francis Watts: It is difficult to put a motion of that kind to a conference of this description, because even although

on this visit I am not one of the Department of Agriculture of Jamaica, I am so connected with this Conference that I cannot, with any propriety, put such a resolution to this meeting. But I most cordially approve of it myself, and suggest that it be recorded in the archives of this conference. I am sure the visiting delegates will agree most heartily with me that this should be done. (applause).

Mr. Bovell: Before we close, I would like to move another resolution and that is one of thanks to the Governors of the Institute of Jamaica and to the Secretary, for the use of their hall for our meeting. I move such a resolution.

Professor Ballou: If any support of the resolution is necessary, I will be glad to support it.

Sir Francis Watts: This is a resolution I can put to the meeting. We highly appreciate the kind courte-y that has been extended to us in allowing us to have our meetings here. This hall has served our purpose admirably. I am afraid we have given the Secretary some little inconvenience, but he has not in the slightest degree resented it. He has done all he can to help us, and we wish to thank him and the Governors most heartily. I ask you to record it in usual way, because it is a resolution I can put to the meeting

The resolution was unanimously carried.

Mr. Cousins: Sir Francis Watts and gentlemen: apparently it falls to me by diminution of the representatives of Jamaica, to move what I consider to be the most important resolution of the day; and that is the hearty thanks and appreciation of Jamaica, its Government and its people and all the gentlemen who attended this Conference, to Sir Francis Watts, the President, and also to the visitors from England who have come out here, to meet us in real flesh and give us, some of them, ideas and knowledge. Also we wish to thank heartily those colleagues from the other West Indian islands, many of whom we are seeing for the first time in the flesh, and whose names, some of them, have been honoured words in the literature of agricultural advancement in the West Indies (hear, hear). We have these men now associated with us in the flesh, and we realize that they are not only good people, but they are men whom we would like to get closer to, to get greater benefit from their wisdom and experience. I tender to you in the name of the Government and people of Jamaica—I know it is the unanimous wish of everybody in Jamaica to thank you, sir, and all the delegates, for the immense amount of inconvenience and trouble you have taken to come here; and we appreciate most heartily and sincerely everything you have done for our benefit (app ause).

Mr. R. H. Spooner: I wish to second Mr. Cousins' motion. In doing so, I cordially agree with everything that he has said. I imagine one of the objects, perhaps the principal, attaching to this Conference held here, was to further the interests of the Agricultural College in Trinidad. If that was the object, then I think that object has been achieved. We have had the advantage of meeting men of science in the front ranks here in the West Indies, and the Old Country. This is a great advantage. As an old agriculturalist, I can vouch for the assistance that agriculturists will receive from the scientists—I do not know how the cane industry in the West Indies would be alive to-day except for the scientists, and we can bear witness to the excellent work that Sir Francis Watts, then Mr. Watts, did in the Leeward Islands, when he saved the sugar industry at a time the old Bourbon cane was completely wiped out in two years. We would have been left stranded without scientific assistance, and I have not the slightest

doubt that disease would have cleaned out our cane cultivations, The same thing can be said with respect to cotton, and nearly every industry that we have, —when dying they have been saved by the work of the scientific men we have had at our backs (hear, hear). The scientist may take a little time to find the remedy, but in the long run he finds it. It is a most important bond, and the close connection that will be established, I am quite sure, between the islands, bound by ties of scientific investigation, will be of use and assistance to us all —a factor for strength That we are to have a headquarters fount of science in the West Indies to deal with our troubles is a most important matter. There is only one regret I have in connection with the matter, and that is that the time of Sir Francis Watts' leadership of the College is coming to a close—all too early for us. We cannot help the changes of time. But we must regret the fact, seriously regret the fact, that Sir Francis Watts, with his knowledge of the West Indies, his ability, general administrative capacity, and great popularity should have to give up a post of this kind before the institution is absolutely firmly and solidly on its legs. I suppose men of administrative capacity can be obtained all right, but I do not think that everybody can be obtained with Sir Francis Watts' peculiar qualifications, for the post. (Applause).

Mr. R. S. Gamble: Mr. President, and gentlemen, I should very much like to associate myself in all that has been said by Mr. Cousins and Mr. Spooner. I do not want to take up much time, because I can add nothing to what they have said. But I take the liberty of putting this motion to the meeting, as it is such a motion that it is not right it should be put to you by the President himself. Those in favour of the resolution will please signify in the usual way.

The resolution was unanimously carried.

Sir Francis Watts: We are now terminating our proceedings. You have kindly passed a resolution, thanking the delegates who have come to this conference, and taken part in it. You have kindly coupled with that my name. I don't think we are in a position here to call on the various people to respond, so I will take the task on my shoulders, and extend to you the great thanks of the visiting delegates, for what you have done for us all. We thank you sincerely.

I now declare the Conference closed. (Applause).

Appendix A.

DIE-BACK OF LIMES (Citrus medica var. acida).

BY

E. A. Walters, Agricultural Supt., St. Lucia.

During the past few years some alarm has been caused by the occurrence of a sickness of the Lime (*C. medica* var. *acida*), this sickness has been called "Die-back of Lime" and appears in Saint Lucia somewhat commonly. The signs of sickness are in order of sequence, yellowing, and falling of leaves, casting of fruit, the young tips of branches then turn brown and finally grey, and latterly the trouble extends to a main branch which will then dry up. This is followed by an increase in sucker production towards the base of the tree, these suckers, however appear quite healthy; occasional gumming also takes place. No signs

of Wither Tip Disease or other parasitical disease can be observed, or is responsible for this dying back, but saprophytes and insect parasites especially the Coccidae, appear as the branch dries up.

Such a state of sickness of limes was prevalent at Reunion Experimental Station, St. Lucia, during the early part of the year 1923.

An effort has been made during this year (1923) to determine the causes of this sickness.

It has been observed that in almost every case of die-back throughout Saint Lucia, soil conditions have been bad; the soil of the lime plot at Reunion contains a large proportion of quartz crystals, and a notable lack of humus; such soil hardens down into a tight packed mass, although the surface may still possess a thin loose mulch, wherein quartz crystals glitter in the sun.

Other cases of die-back in St. Lucia are to be found on similar soil, especially where cultivation is neglected, drainage bad, and weeds flourish.

A remarkable recovery of such affected trees has been brought about by increased deep digging, and applications of large amount of humus, this, with spraying of the trees with an insecticides pruning of the dead branches, has resulted in a cessation of die-back and production of a profusion of foliage rich in chlorophyll, on branches which now bear good crops of sound fruit; gumming also has ceased and the trees appear quite healthy.

The Wilting Point of the Lime Tree.

It would appear that the Lime tree is liable to wilt when certain conditions obtain in the soil and atmosphere. This wilting of foliage occurred daily during the drier part of the year and previous to the application of humus and the improvement of soil tilth by digging—and took place when the air temperature stood at 88° F., and soil temperature at a depth of one foot, at 83° F.; surface soil being then dust-dry and the sub-soil slightly moist, but hard packed.

With the application of humus, deep digging, and generally increased care, yet with the same meteorological conditions obtaining, a gradual recovery has been made by the affected trees, excessive wilting has ceased and the limes have become quite healthy, all this has occurred before the rain season, so that the results cannot be confounded with the general re-invigoration of plant life following the increased water supply obtained from heavy rainfall.

It would therefore be apparent that the majority of cases of die-back under these conditions as found in St. Lucia, can be remedied by improved cultivation.

There is a general tendency amongst planters to leave the lime tree to fight its own battle in an adverse environment, and to read a desire to attribute to pathological causes, what is really a physiological disease, the remedy for which lies in the hands of the planter, namely:—improved cultivation.

Effects of Casuarina Species on Limes.

It has been observed that the Casuarina where growing near lime plantations has a decided ill effect on the health of the lime plant.

At the Experimental Station, Reunion, both where seedling are grown and where established limes stand, species of the genus *Casuarina* are found within a distance of fiftten to twenty-five feet, forming a wind-break.

These seedling beds run at right angles to the wind-break, and commencing at a distance of twenty-five feet from the wind-break and for a length of 10 feet inwards, the seedling lime plants are dwarfed and sickly, whilst the remainder of the seedling limes, outside the range

of needlefall and root penetration of the *Casuarina*, are vigorous and healthy; much the same effect is observed on established trees, where growth is poor and flowering neglible.

These very pronounced effects of stunting and poor growth are not produced by over shading from the wind-break, as this is kept pruned back, but it would seem that even if there is no *toxic* effect on these limes due to the resinous character of genus *Casuarina*, there *is* a decided *restriction* of *water supply*, owing to the absorptive power and reach of the *Casuarina* roots; such evidence forces one to the conclusion that the use of *Casuarina* as a wind-break for lime plantations should be discouraged, because of the aridity produced within a run of twenty to thirty-five feet from the bases of trees belonging to this genus *Casuarina*.

Appendix B.

"A REVIEW OF SOME DIFFICULTIES OF THE EXPORTER OF AGRICULTURAL PRODUCE."

BY

E. A. Walters, Agricultural Supt., St. Lucia.

The present paper comprises an account of the experience of the exporters of agricultural produce where such produce is derived from the agricultural industries of St. Lucia, and exported by planters to the London markets; the information is obtained from local planters who have suffered much from the heavy outside charges made upon the exported produce; and the opportunity is taken of laying the information before the Agricultural Conference in the hope that a thorough ventilation of the handicap under which the exporter of agricultural produce is expected to survive, may lead to some useful discussion of a pressing problem.

An apology is needed in putting forward such a paper on exports problems, which at first sight may be regarded as outside the scope of a purely agricultural body, since however the survival of the agricultural community is the raison d'être of advisory agricultural bodies, the writer considers the problem appropriate for the consideration of the present Agricultural Conference.

For the purpose of reliable data, copies of account sales certified to be correct are attached to which reference will be made from time to time.

In proposing the inception of new industries and in endeavouring to increase production of established agricultural production, the ever-recurrent argument is advanced by the agricultural producer to the effect that—"it doesn't pay." This is no doubt the greatest objection of the present time which continually confronts the agricultural adviser of to-day in his search for means to improve production; when therefore evidence comes to hand to confirm such statements of debit trade, it is necessary to thoroughly search out the cause, and if possible to apply the remedy. It is true that many schemes go to the wall owing to the financial loss due to export difficulties when such schemes may have been ideal in all other respects with regard to production of an agricultural article such as soil, climate, labour and consumption; when, however, the export charges are excessive, these charges form a limiting factor and production will tend to decrease or cease. Such cases are familiar to present advisers of agricultural progress.

The following products are examples of excessive charges as stated above: sugar, coconuts, l me oil.

Sugar.—With regard to this important product, it should be observed that the manufactured sugar was held n St. Lucia for a period o one year after manufacture in order to comply with the prohibition on sale in the home markets. When this prohibition was removed the sugar imported into the London market was stored for a further five months, this second period of storage was stated to be due to restrictions on sale by home authorities which prevented the sale of the product.

Duty.—On the certified account sales provided, of 14 barrels of sugar La Perle Syndicate, valued at £32 19s. 1d. duty amounts to a charge of £18 16s. 6d. or more than one-third the sugar value. Wharf charges and port rates amount to £2 1s. 4d. These two items with other charges total £28 0s. 5d., leaving a balance to the credit of the exporter of £4 18s. 5d.; thus the producer has received one-seventh of the value of the exported goods

Coconut—Experiments have been made by exporters of coconuts in an endeavour to determine the best method of preparing nuts for export on lines which may be followed without pecuniary loss ensuing. In the first case, nuts were shipped after being partially husked all over in bags. These were declined by the markets, and clean nuts were advised as more suitable. A second trial shipment consisted of nuts which had sufficient fibre left to protect the "eye" being otherwise clean. These were also shipped in bags; the brokers intimated that such shipments were undesirable.

It was found that nuts shipped in bags were treated roughly, were liable to injury by rodents and the bags themselves were sometimes torn, and had to be re-s wn, for which charges were made, as shown by a debit of 7/ on the account sales of 6 bags of nuts; public sale 1st March, 1922, Ross and Norton.

A third trial shipment contained nuts clean husked and packed in 3 salt-fish casks; these nuts arrived in sound condition, the charges however, were so excessive that no credit accrued to the exporter. A further complaint made by the importer was to the effect that such casks were too large.

The final shipment consisted of clean-husked nuts in cement barrels, these barrels are of smaller dimensions than salt-fish barrels. Two such casks were shipped. This shipment also resulted in loss, no credit balance remaining after all charges were settled.

Hand Pressed Lime Oil—With regard to hand pressed lime oil an account sales copy supplied shows that on 2 cases of lime oil shipped from St. Lucia, the wharf and port rates amount to £1 4s. 2d. This is the largest debit item on the account sales copy and together with all other charges considerably reduces the amounts credited to the producer, viz., value of 2 cases of lime oil containing 31lbs. 14 ozs. as shipped £9 11s. 3d.; total charges amount to £2 4s. 6d., return on produce to the shipper, £7 6s. 6d.

These charges form a subject for discussion which appeared in West India Committee Circular of July 19th, 1923, page 324, column 1, entitled Freight Rates, where comparisons were made between a case of Transvaal oranges weighing from 70 lbs. to 80 lbs. was put on the London market at a total charges cost of 14/ whilst a case of West Indian lime oil weighing from 15 to 16 lbs. and not requiring special storage, was put on the market at a cost of £1 2s. 4d. or with local charges and packing, a total cost of £1 7s. 6d. per case. These charges in each not including cost of production.

In reply to this, a comment was made by the West India Committee Circular amongst other things on the lack of a standardised packing method which was stated to be responsible for a considerable amount of handling and charged accordingly. With regard to this comment a more suitable drum container is now being used by several exporters which requires no further packing. It will be interesting to observe what reduction in charges follow this adoption of a standard package.

Kola.—When shipped from Saint Lucia has resulted in net proceeds of from 1/6 and 2/6 per bag up to 7/6. When such low returns are received the producer will not trouble to collect his crop.

As shown above these productions are heavily handicapped by outside charges, which in many cases are the deciding factor between production of a crop, or total neglect of ready produce, so that planters despair of finding a crop which may be produced and marketed at a cost which will reimburse their expenditure and provide a working profit; outside charges are bound to occur, but when uch charges are excessive, production of the article ceases and an all-round loss to trade ensues.

It is possible that a ventilation of these export charges may result in decisions which if brought to the notice of the responsible authorities may bring about a workable scheme of charges which provide a fair return to the producer whilst ensuring him favourable marketing facilities for his product.

Ross & Norton,

(Sole partner, F. R. Norton),

Leadenhall Buildings, London, E.C. 3.

Account sale of 6 bags coconuts ex "Scientist" s.s. from St Lucia. Sold at public sale 1st March, 1922. Prompt 4th March, 1922.

For Account of La Perle Syndicate.

	K L. P		
4 bags at 14/6 p.b.	£2 18 0		
2 bags (broken and resewn at 7/ p.b.)	0 14 0	£3 12 0	
Freight & primage 6 at 6/6 and 10 per cent.	2 2 11		
Int. 1 month at 6 p.c. ..	0 0 3		
Wharf charges and port rates ..	0 10 10		
Public sales expenses, cartage, etc.	0 6 5		
Fire insurance	0 0 3		
Brokerage	0 1 0		
Commission 2½ per cent. ..	0 1 10		
Insurance £6 and stamp ..	0 0 7	3 4 1	
F. P. A. and War ..		0 7 11	

(Sgd.) Ross & Norton.

Certified correct copy. (Sgd.) I. G. Wakely,
18.12.23. Magistrate.
E. & O. E.
London 24th March, 1922.

ROSS & NORTON,
(Sole partner F. H. Norton).
Leadenhall Buildings, London, E.C. 3.

Account sale of 14 barrels sugar ex "Dramatist" s.s. from St. Lucia. Sold by private contract 25th October and 1st November, 1922. Prompt (Average) 1st December, 1922.

To Account of La Perle Syndicate.

K
L P

	cwt.	q.	lb.		£	s.	d.	£	s.	d.
8 brls.	24	0	1	25/						
				2/1						
	2	0	0							
	22	0	1	at 20/9	22	16	8			
				Discount 1%	0	4	7			
								22	12	1
5 brls.	15	1	11	25/						
				2/4						
	1	1	18							
	13	3	21	at 15/	10	9	1			
				Discount 1 %	0	2	1			
								10	7	0
								£32	19	1
Freight on 14 barls. c 38. 10. at 52/6					4	19	11			
Int. 5 mnths. at 6 per cent. ..					0	2	6			
Wharf charges; and port rates ..					2	1	4			
Duty on c. 36.2.15. at 10/3.34 ..					18	16	6			
Int. on duty					0	1	7			
Rent					0	11	3			
Fire insurance					0	1	1			
Commission and brokerage 3½ per cent.					1	3	1			
Insurance £28 and stamp ..					0	3	2	28	0	5
								£4	19	8

(F.P A. and War)
Certified correct copy.
18/12/23
(Sgd) I. G. WAKELY,
Magistrate.

E. and O.E
London, 13th December, 1922.

(Sgd.) Ross & NORTON.

Ross & NORTON
(Sole partner F. H. Norton)

Leadenhall Buildings, London E.C. 3.

Account sale of 5 casks Coconuts ex "Comedian" s.s. from St. Lucia. Sold 6th February, 1922, Prompt.

For Account of La Perle Syndicate.

K
L P

3 casks at 20/ per cask ..	£3 0 0		
Wharf charges 12/6, cartage and P.S. charges, etc. 11/6, brokerage 1/ ..	1 5 0	£1 15	0
F F.			
2 casks at 11 per cask ..	£1 2 0		
Wharf charges 3 10, cartage and P.S. charges, etc., 7/7, brokerage 1/ ..	0 12 5	0 9	7
		2 4	7
Freight as 10 bags at H.S. and 10 p.c.	£2 4 0		
Fire and Marine Insurance Commission	0 0 7	2 4	7

(Sgd.) Ross & Norton.

Certified correct copy
18.12.23
(Sgd.) I. G. Wakely,
Magistrate.

London, 16th March, 1923.
E. & O.E.

Ross & Norton
(Sole partner F. H. Norton)
Leadenhall Buildings, London, E.C. 3.

Account sales of 2 cases Lime Oil ex "Intaba" s.s. from St. Lucia.
Sold 17th March, 1923. Prompt 6th April, 1923.

For Account of La Perle Syndicate.

K
L P

	cwt.	q.	lb.	oz.			
2 cases	0	2	13	6			
		1	9	8			
	0	1	3	14			
31 lb. 14 oz. at 6/					£9 11	3	£9 11 3
Freight 2 ft. 5. at 80/ 10 p.c. ..					0 5	4	
£9 12/ at 1 per cent. ..					0 1	11	
Wharf charges Interest 1 mnth. and port rates					1 4	2	
Rent 7 weeks					0 0	9	
Fire Insurance					0 0	6	
Commission and brokerage 3½ per cent.					0 6	8	
Insurance £12 and stamp ..					0 5	5	2 4 9
(on deck and war)							£7 6 6

(Sgd.) Ross & Norton.

Certified correct copy.
18.12.23
(Sgd.) I. G. Wakely,
Magistrate.

London, 13th April, 1923.
E. &. O.E.

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